JAN 7 1925

Annual Progress and Statistical Issue

Electrical World

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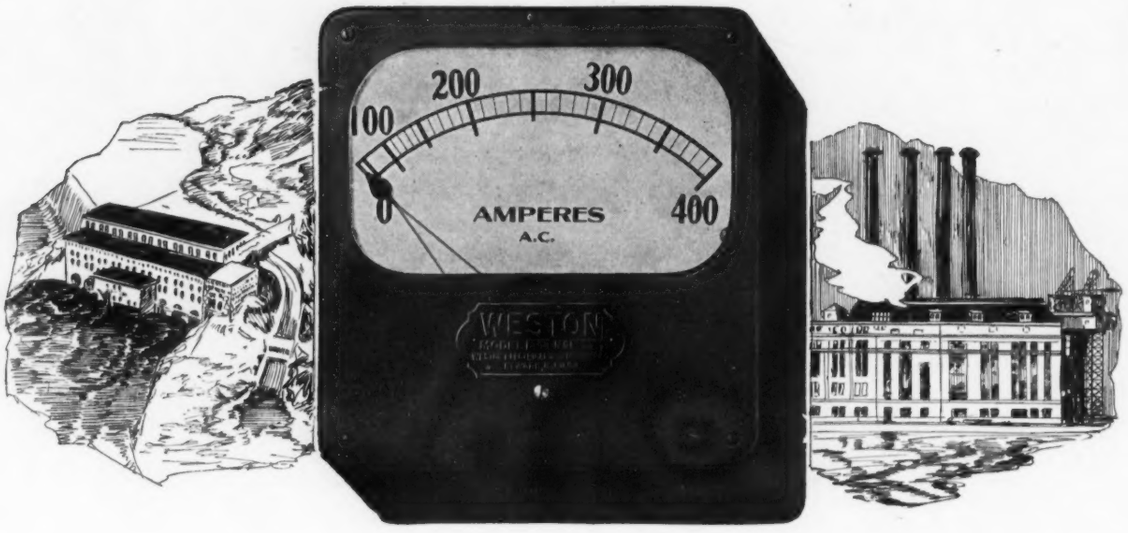

A good resolution for the New Year

No designer or engineer can make a better resolution than to give Weston Rectangulars a trial on his property during 1925.

Announced less than a year ago—these splendid instruments have made friends everywhere with engineers, designers, consulting engineers, operators and others both up and down the line of engineering and operating staffs.

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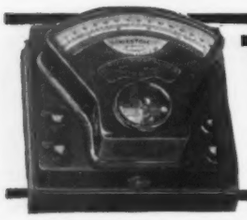
The response of the industry to Weston's 1924 contribution—the Weston Rectangular Instrument—has been prompt and decisive.

We feel gratified that the industry has thus placed its approval upon the sincere efforts that we have made to properly serve them.

Weston Electrical Instrument Co., 13 Weston Ave., Newark, N. J.



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Electrical World

THE CONSOLIDATION OF ELECTRICAL WORLD, ELECTRICAL ENGINEER AND AMERICAN ELECTRICIAN

Published by McGraw-Hill Company, Inc.

W. H. ONKEN, JR.

Editor

VOLUME 85 — *New York, Saturday, January 3, 1925* — NUMBER 1

A Memorial to the Pioneers of Niagara Falls

THE hydro-electric developments at Niagara Falls have had a controlling influence on the development of the light and power industry. Here were fought the battle of the phases, the battle of the frequencies, the battle of alternating versus direct current and the battle of high-voltage transmission.

Here on May 6, 1893, it was decided to use very large turbo-generator units to generate two-phase alternating current. Here, also in 1893, it was decided to use a two-phase, 11,000-volt alternating-current transmission system, and on August 26, 1895, the Pittsburgh Reduction Company received alternating-current power. The influence of these decisions and these developments in establishing the modern electrical industry has never been properly celebrated.

A memorial tablet placed on the portal of old Power House No. 1, at Niagara Falls, is being unveiled today with fitting ceremonies in tribute to the pioneers who developed the great site. This tablet was donated by Edward D. Adams, whose courage, engineering ability and force of personality established his leadership among the pioneers of Niagara Falls. It is dedicated to the memory of those scientists, financiers and engineers whose work and vision made possible electrical Niagara, and the whole electrical industry welcomes this thoughtful memorial to the pioneers.

The Remarkable Performance of the Electrical Industry

FOR the electrical industry the year 1924 was remarkable in many respects. New records were established and greater efficiency in performance was recorded. Most notable of all was the stupendous sum raised by the electric light and power companies for new developments and extensions. In a year when the current of business was inactive and stagnant, for the utilities to sell a billion and a quarter of securities is a feat worthy of a monetary Colossus. It shows the financial stability of the industry and indicates a condition of improved public relations and general good will.

Inasmuch as the greater part of the electricity used in this country is, and must continue to be, generated from steam, the enhanced efficiency in the use of coal is a tribute to the genius and skill of the operating engineers. So is also the progress made in the interconnection of generating systems. In the face of higher costs of all that goes into the production of electricity, it is essential that a maximum use be made of the investment in power houses and distribution systems, if the cost of the service is to remain at its present low level or go lower. This truth is generally recognized by executives and engineers, and it is gratifying to note how assiduously and successfully the engineers are applying themselves to the task.

In the other branches of the industry the business depression has not been without its effect. However, the feeling that there are better times in store and much actual business in sight has quelled any disposition to complain. The cumulative effect of the home-lighting and other campaigns, of the great expenditures for new developments by the electric light and power companies, of the trend toward more and more labor-saving machinery forced by the scarcity and high cost of labor in the factory, on the farm and in the home, must manifest itself in greater production during 1925. General business is already on the mend, and this is reflected in the greatly augmented output of the power houses during the past month. Thus the industry can look forward with confidence to a year of more than usual prosperity, a year in which all previous records will be eclipsed and in which, in an atmosphere of greater harmony and more widespread public appreciation than have always obtained, past achievements can be made the stepping stones to new ones.

The Electrical Family Reunion of 1924—A Retrospect

MEN of the electrical industry take pride in having accomplished a big task in the world and are confident that the future holds promises of equally great achievements, for they realize the fascination, the potency and the universality of the weapon they wield for the enrichment of civilization. Yet they are busy men and seldom attain the leisure or seek the perspective to visualize the many notable accomplishments recorded and the many major developments planned for the future. They are occupied with their daily tasks and are pressed by the necessity of realizing in some measure the possibilities in their respective branches of the industry. The descendants of the original electrical Adam have become so numerous that family reunions are needed to bring them into touch with each other and with the family activities.

In some degree the staff of the ELECTRICAL WORLD has at the end of the year sought to measure the accomplishments of electrical men in 1924. It has condensed them into statistics and articles for the benefit of the industry. But this statistical issue, representing in a sense an annual reunion of the electrical family, is full of untold history and hidden romance. Back of all the figures, all the charts and all the pictures are hundreds of untold human stories of the work, of invention, of failure, of success, of joy and of sadness; for men did these things which are recorded.

The financial members of the family have raised more than a billion dollars of capital for their industry, and their task has been made easy by the efficient work of other members in giving good service. For good service means good public relations, adequate income and ample credit.

The executive members have carried on the many

electrical activities successfully, and during a year in which general industry has been beclouded they have made the electrical branch the one bright star in the business firmament. They have brought about greater popularity for electricity, they have obtained more customer partners; they have planned wisely for future developments. In their hands the electrical industry has waxed fat and flourished as never before. They have kept the faith.

There is, besides, a quiet, busy and reserved group in the family whose work is foundational to the success of the other members. The engineers who plan, build, operate and invent belong in the inner circle, for their work motivates the whole family and their success or failure makes or mars the complete family accomplishment. Progress, efficiency, knowledge and economy are the watchwords with which they labor to make electricity more and more potent in human affairs. And they, too, have the pleasure of recording a year of accomplishment; for, although not particularly noted for striking achievements, the past year with its pressure for economies has resulted in engineers consolidating past gains to secure savings and to obtain efficiency to a degree which will enable them to go forward this year with greater certainty and greater speed.

All members of the family did their part and showed no weakness and no laziness. Their spirit and loyalty were never more evident than now, and during 1925 the electrical men, stimulated by their environment and imbued with faith, are going forward to new heights of record-breaking achievement.

Future Illuminants in the Light of Present Ones

WE ARE often reminded that modern artificial light sources are of low absolute efficiency; that is, that only a small percentage of the total energy input is emitted as visible radiation or light. It is easy to quote such figures and to predict great advances because such advances are theoretically possible. Of course, it would be folly to prophesy that men will go on forever producing light by methods identical or closely akin to those now employed, but certainly those who are ambitious to produce an artificial light source which will emit most of its energy as visible radiation have a big job on their hands if this new light source is to compete with present electric lamps in size, brightness, cost, safety, dependability and convenience.

Doubtless, improvements will still be made in filaments so that higher operating temperatures will be practicable. Changes in character of the surface and in the crystalline structure and new alloys are possibilities. Even carbon may come back as a filament material, and arcs confined in bulbs may be greatly improved. Theoretically, a fascinating avenue lies along the line of electrically excited gases and fluorescence. The electric discharge tube has been existent for years, and its use has been recently revived to some extent in signs.

But in the consideration of the future the practical requirements are not to be overlooked. Modern filament lamps are safe because they are inclosed in glass. Such light sources, equivalent to a thousand candles, are confined in bulbs of small size. The lamps are cheap and need no attention for hundreds of hours. They can be replaced by any one. A great range in candlepower is possible without much change in efficiency. These are practical qualities of such great importance that a new illuminant must come close to equaling them besides merely providing light at a higher efficiency.

Improvements are bound to come, but success in the purely scientific aspects will not necessarily be a practical success. Artificial light sources of the present, crude as they may be from the viewpoint of theoretical possibilities, are really wonderfully satisfactory from a practical viewpoint.

News of the Industry in 1924

EXPANSION and consolidation are the two words which sum up the weekly history of the electric light and power industry in the year which has just closed. In every part of the country great steam and hydro-electric plants have been finished, started or definitely planned. Names like Kearny, Waukegan, Richmond, Philo, Montaup, Crawford Avenue, Hudson Avenue, Cahokia, High Bridge, Valmont, Long Beach and Oak Grove, which a year ago had not been entered or were still new in the catalog of central stations, have acquired a familiar ring, and these designations are only a few selected at random from a long list. Holding companies have extended their operations on every hand until today were it not for the non-competitive nature of the industry they would resemble nothing so much as the rival strings of grocery and other stores which dot the country, some confined to comparatively compact territory, some widely scattered, some operating in a circle, a triangle, a parallelogram or a straight line, others composed of isolated units with an appearance of haphazard acquisition, though doubtless there were reason and design behind their purchase. For both holding and operating companies 1924 has set a pace that 1925 will do well to equal, let alone surpass.

The steady progress of interconnection east, west, north and south and the systematic extension of both experimental and permanent farm service have been matters of almost weekly record. The determined and thus far fruitless struggle of opposing ideas concerning Muscle Shoals has inevitably filled much space. The strife over Boulder Dam and the development of the Colorado River, with Arizona still thwarting the seven-state treaty; the fishery question as it affects the Columbia, the Klamath and other great Western rivers, and the fight for and against the canalization of the St. Lawrence in the interests of power as much as navigation have been constantly recurring topics.

In California an unparalleled drought was met by the light and power companies with such energy and resource that a grave disaster was splendidly averted. The companies had their reward when in November the public ownership bill went down to its second crushing defeat. A bill of similar import also met with a decisive rejection in the State of Washington. The friendly attitude which the advisory committee on Pennsylvania's "Giant Power Survey" assumed toward the private companies and the decision of the New York State authorities to drop their suit to annul the federal water-power act were other political happenings of good omen to the industry, which by its persistent cultivation of friendly public relations is becoming more and more free from the menace of public ownership.

Outstanding among great electrical gatherings was

the first World Power Conference, held in London, which took to Europe many leaders in American central-station and engineering life and did much to stimulate a "give and take" of friendly counsel between the continents. The national and geographic assemblies of the American Institute of Electrical Engineers and the National Electric Light Association were, as always, aids to future progress as well as mirrors of progress just achieved. The "better-home-lighting" contest in which the association was the chief mover was a noteworthy event the success of which exceeded sanguine expectations. Altogether it was a remarkable year, when past achievements were excelled and ambitions yet to be achieved were pitched still higher.

The inevitable cloud that mortality casts on all human affairs did not fail to fall on the electrical industry. From its ranks have passed in the last twelvemonth Benjamin G. Lamme, for twenty years the ranking engineer of the great Westinghouse manufacturing company; Henry M. Byllesby, pre-eminent as an organizer and executive; Dr. E. F. Nichols, director of pure-science research at the Cleveland laboratory; Thomas Commerford Martin, editor, writer and secretary; John L. Harper of Niagara Falls, Arthur S. Huey of Chicago, Donald McDonald of Louisville, Walter Neumuller of New York and many another good man and true. In Europe within the space of four months C. E. L. Brown, the founder, and Walter Boveri, the president of the world-famed Brown-Boveri Company, joined the silent majority.

Engineering Jobs to Be Done

ELECTRIC power now reigns supreme in industry wherever movement is the thing desired. Electrical illumination has become the standard for comfort, convenience and adequacy. Electrical communication by wire and by radio has enabled the world to converse and become a great family. These things can be recorded for the glory of electrical engineers at the beginning of 1925. What remains to be done? This to a layman may seem a pertinent question, but the engineers themselves realize that they face opportunities for accomplishments still greater than those recorded. Their plans are made and their hands and brains are active, for the goals sought promise much to them and to the world.

In industry electric power is used very largely in motors only, and the induction motor represents the greater part of the industrial load. Yet there are virgin fields left in industry for electrical applications which hold promise of even greater magnitude. Every ore produced from nature offers many possibilities for electrical applications before it finally comes into use as a tool or other aid to man. In refining, smelting, heat-treating, alloying, testing and manufacturing electricity can be used to advantage once the processes and the equipments have been produced by engineers. Every useful thing made in industry requiring work to be done on it offers possibilities for electrical applications. In painting, in enameling, in welding, in fabricating, in measuring and in assembling there are direct applications of electricity for heating, for conveying, for testing and for doing work in a better way than it is now done.

In the field of transportation only the surface is scratched, and the near future will see the electrification of all railroad terminals, for public sentiment will soon force the abolition of the smoke nuisance from city environs—the smoke-making locomotive and the fuming factory, steamer and tug are doomed to extinction for many reasons other than those involving cost. The electric truck and tractor are yet to be used in cities and factories to the full limit of their economic possibilities. And then there is a fruitful field of development in electric signaling for transportation by rail and on streets. Safety, comfort, economy and efficiency all point to rapid advances along these lines.

Not the least interesting field of activity, however, lies in the greater use of electricity in the home. Radio has come to stay and in itself is subject to great development before it will approach perfection for home use. There are, besides, many other things, some of them developed and some of them only foreseen. Electric conveniences, such as flatirons, curling irons, vacuum cleaners, dish washers, washing machines, hot-water heaters, radiant stoves, percolators, toasters, waffle irons and refrigerators, are here to stay, and these alone when placed in countless homes now without them will use more electricity than is now produced. But engineers and architects have visions even more complete of the future home which shall be designed to operate electrically, to save walking, to save work and to be more convenient and attractive. The real electrical home is more than the filling of a house with appliances; it is a unit designed to utilize electricity fully in home life. It is yet to be created, but it will soon come.

Then there are still other fields whose surfaces have been only scratched, such as electro-therapeutics. Modern surgeons and dentists have just begun to realize what a useful agent electricity is as a tool, as a light and as a specific. Through tools, illumination and X-ray equipments, operations now impossible will become facts. Electrical applications will make existing operations safer, surer and quicker. They will remodel hospitals and hospital methods. These things are not dreams; they are things now being realized in many places, and no developments will be more gladly received than those which apply directly to human ailments.

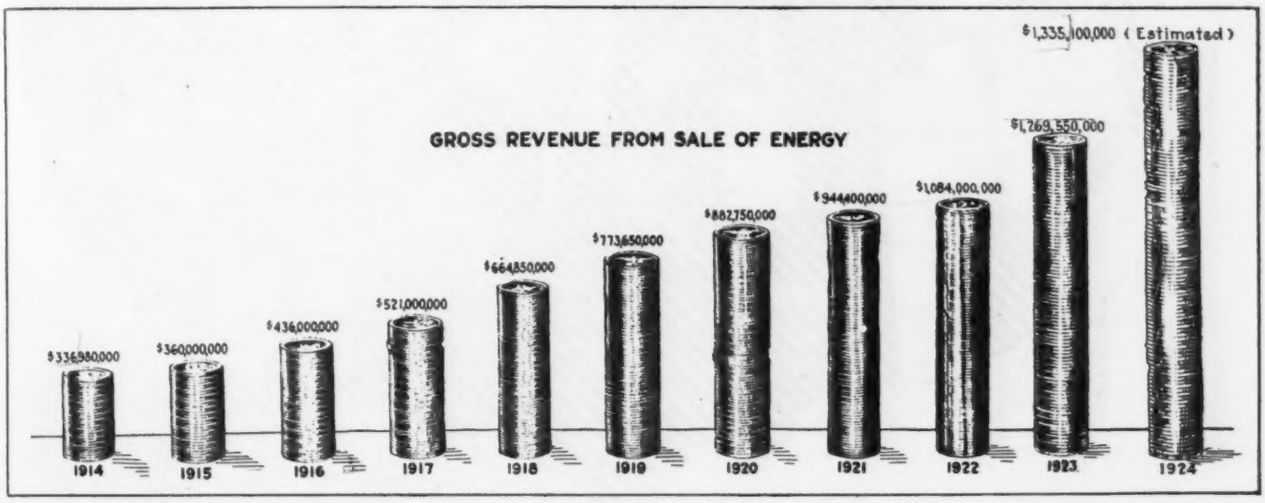
Many other new uses for electricity can be seen on the horizon by engineers, and these uses introduce problems directly bearing on electrical generation, transmission and distribution. The things prophesied are necessary if electricity is to be used fully and completely in life, and there are many technical problems connected with them which are yet unsolved. Fuel must be used at a greater thermal efficiency than 20 per cent. Energy must be transmitted and distributed at a greater efficiency than 75 per cent. It must be utilized in machinery at a greater efficiency than 85 to 90 per cent. Higher voltages, better regulation, better control, better equipment and more economical operations must be brought about, and, to cap all, great systems of stations, lines and distribution networks must be consolidated, interconnected and operated to carry to completion the possibilities for a national power supply.

As long as these things are docketed engineers will never lack for work or for incentives. Their work now lies ahead and is known to be difficult, but their courage can be counted upon, and a few more years will see the present docket replaced with one still more fascinating and still more extensive. The engineer is and always will be indispensable to electrical progress.

THE SEASON'S GREETINGS

A Year of New Records

The Electric Light and Power Industry Increased the Energy Generated by 5.9 per Cent and Its Gross Revenue by 5.2 per Cent During 1924—Proportionate Decrease in Hydro-Electric Energy Indicated



THE FINANCIAL HISTORY OF THE CENTRAL-STATION INDUSTRY HAS BEEN UNIQUE IN THAT IT HAS NEVER RECORDED A DECREASE IN ANNUAL REVENUE

ONE OF the attributes which make the electric light and power industry stand out in a class by itself and on a plane higher than perhaps any other primary industry in the country is its ability to withstand unsatisfactory general economic conditions. The first three-quarters of 1924 witnessed a general slump in business conditions, and most of the primary industries were operating far below the estimated normal. As a result the revenue of industry at large took a decided drop during the year.

The electric light and power industry, on the other hand, exhibited a far different condition. Despite the generally curtailed industrial energy requirements, the energy generated during 1924 is estimated at 53,937,400,000 kw.-hr., or 5.9 per cent over that of 1923, the former record year of the industry. Moreover, the gross revenue was 5.2 per cent above that of 1923, a very substantial gain considering the general economic conditions of industry as a whole. These gross-revenue figures during a year of general industrial sub-activity are all the more surprising and significant when the fact is remembered that the gains made during the previous year of 1923 were approximately 22 per cent in output and 18 per cent in gross revenue over 1922. To have been able to continue this growth, even though at a reduced rate, during a period of industrial semi-depression is an indication of the basic place which the electric light and power industry has built for itself in the economic structure of the nation. Other primary industries may hesitate and "dig in" until the industrial cycle has taken an upward turn, but the electric light and power industry continues to make new records in production and revenue.

The year 1924 is the first for which data have been

Table I—Generation and Distribution of Central-Station Energy in the United States During 1923 and 1924*

(100 per Cent of the Industry)

Sections	Kw.-Hr. Generated During Year†		Distribution of Energy Generated									
			Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intra-company Business, Including Line Losses, Kw.-Hr.	
	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thousands	1923 Thousands	1924 Thous.	1923 Thous.	1924 Thousands	1923 Thousands
United States	53,937,400	50,887,203	43,505,700	41,060,203	13,097,000	11,201,500	23,894,300	23,930,458	6,514,400	5,928,245	10,431,700	9,827,000
New England	3,648,000	3,654,896	2,863,300	2,869,896	988,000	841,000	1,424,900	1,620,096	450,400	408,800	784,700	785,000
Middle Atlantic	13,700,000	12,940,696	11,168,000	10,547,696	3,930,000	3,345,000	5,704,000	5,709,696	1,534,000	1,493,000	2,532,000	2,393,000
South Atlantic	5,715,000	5,550,555	4,658,000	4,524,555	820,000	687,000	3,383,000	3,395,555	455,000	442,000	1,057,000	1,026,000
East North Central	12,972,000	12,046,252	10,872,000	10,096,252	2,980,000	2,615,000	5,722,000	5,461,252	2,170,000	2,020,000	2,100,000	1,950,000
West North Central	3,512,000	3,556,824	2,944,000	2,980,824	1,455,000	1,277,000	1,371,000	1,597,699	118,000	106,125	568,000	576,000
East South Central	2,003,000	1,825,728	1,566,000	1,427,728	383,000	324,000	830,000	807,728	353,000	296,000	437,000	398,000
West South Central	1,787,400	1,548,143	1,397,400	1,210,643	491,000	414,000	708,400	629,823	198,000	166,820	390,000	337,500
Mountain	2,857,000	2,716,503	2,166,000	2,060,003	435,000	361,500	1,500,000	1,513,803	231,000	184,700	691,000	656,500
Pacific	7,743,000	7,047,606	5,871,000	5,342,606	1,615,000	1,337,000	3,251,000	3,194,806	1,005,000	810,800	1,872,000	1,705,000

* Data are those for the electric light and power industry only and do not include energy generated in purely electric railway plants, Reclamation Service plants or private generating plants. † Based on data collected by the United States Geological Survey for the first ten months of the year.

AREAS PROPORTIONAL TO KILOWATT-HOURS GENERATED

Kilowatt-hours Generated in Fuel Burning Plants - 65.2%

Kilowatt-hours Generated in Hydro Plants - 34.8%

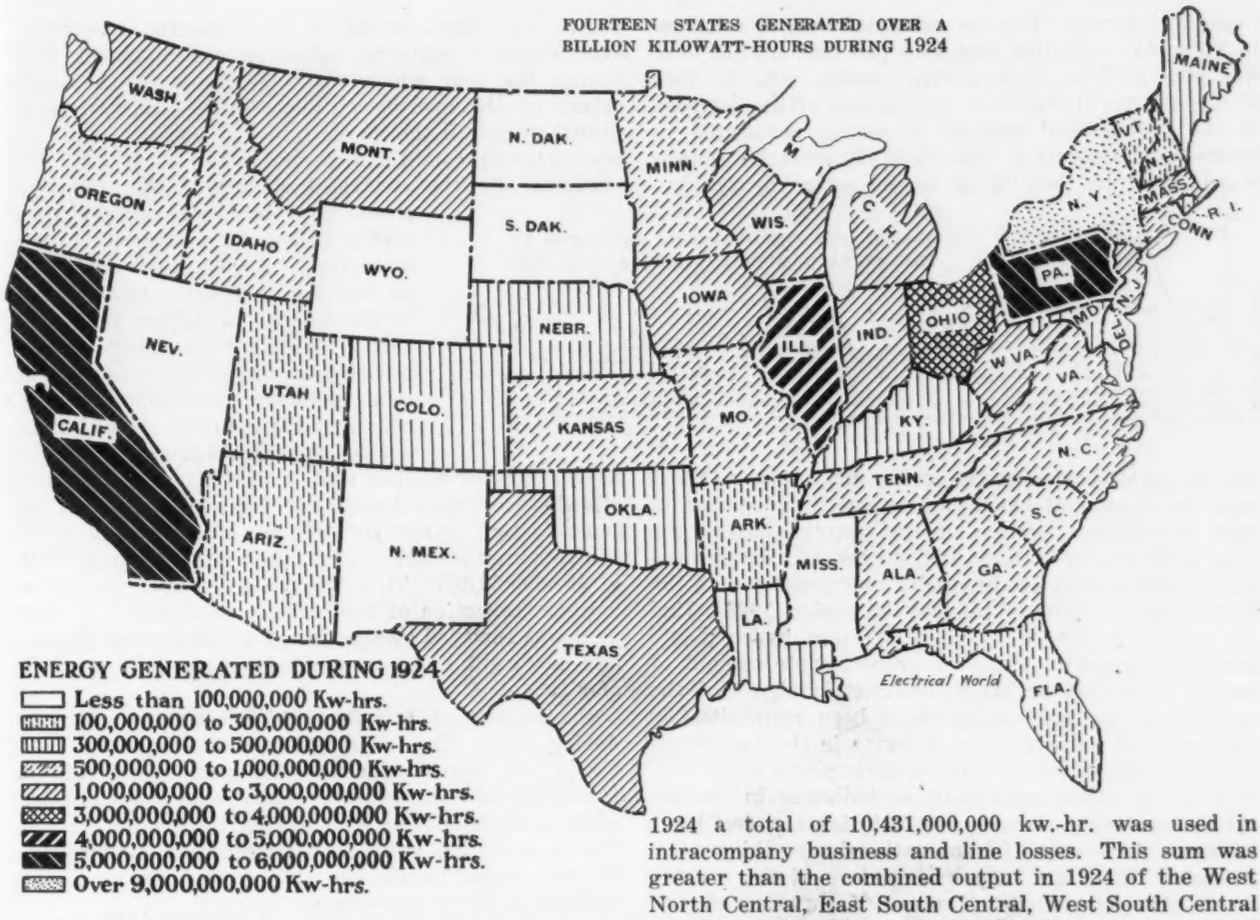
Note—Data based on U.S. Geological Survey Returns for 1923

tabulated showing the amount of energy generated by the electric light and power industry as a unit. This has been made possible by the co-operation of the Power Resources Branch of the United States Geological Survey in furnishing monthly data showing the energy generated by plants other than those of central-station systems. This additional information, taken in conjunction with the monthly production data gathered by the Geological Survey, has made posible figures on the activities of the electric light and power industry alone. This output has been segregated monthly into that generated in hydro and in fuel-burning electric plants, and monthly data have been made available on the fuel consumption in central-station plants. Moreover, during the past year the monthly distribution of central-station energy has been segregated by the ELECTRICAL WORLD as between line losses, light, railways and industrial power, the classification being based on the best information obtainable. During 1924, therefore, large advances were made in the collection and presentation of the monthly operation statistics of the central station companies.

A study of the accompanying tabulations indicates that the industry as a whole sold 5.9 per cent more energy during 1924 than during the year previous. Two sections of the country, however, reported operations for 1924 under those of 1923. New England was especially hard hit by the curtailment in power requirements during the year, as is indicated by the fact that approximately 200,000,000 kw.-hr. less electrical energy was consumed for power purposes in that territory during 1924 than during 1923. Although the lighting requirements for New England increased during the year by almost 150,000,000 kw.-hr., yet the drop in industrial power consumption was sufficient to result in a net decrease in the amount of energy generated in the section during 1924. The revenue obtained from the sale of energy, however, was 1.7 per cent above that

Table II—Increase in Central-Station Financial Operations for the Past Six Years

Sections	Gross Revenue from Sale of Energy					
	1919	1920	1921	1922	1923	1924 (estimated)
United States	$773,650,000	$882,750,000	$944,400,000	$1,072,119,883	$1,269,550,000	$1,335,100,000
New England States	63,890,000	84,570,000	89,050,000	103,885,016	120,200,000	122,200,000
Atlantic States	299,960,000	312,760,000	342,970,000	387,811,179	476,500,000	505,000,000
North Central States	255,030,000	298,680,000	314,600,000	358,079,391	418,350,000	432,500,000
South Central States	53,770,000	68,050,000	77,020,000	76,134,431	103,000,000	107,000,000
Mountain and Pacific	101,000,000	118,690,000	120,760,000	146,209,866	151,500,000	168,400,000
	Operating and Maintenance Expenses					
United States	.....	$440,650,000	$459,370,000	$553,067,982	$656,200,000	$690,800,000
New England States	.....	46,470,000	42,810,000	57,714,838	65,500,000	68,500,000
Atlantic States	.....	150,980,000	161,050,000	202,657,745	249,000,000	264,000,000
North Central States	.....	160,360,000	170,620,000	197,024,529	230,000,000	238,000,000
South Central States	.....	35,980,000	40,640,000	39,132,213	53,000,000	55,000,000
Mountain and Pacific	.....	46,860,000	44,250,000	56,538,657	58,700,000	65,300,000



received during 1923, this being due to a growth in the number of high-revenue lighting customers.

The ability of the electric light and power industry in New England to increase its revenue while at the same time reporting a decrease in the actual number of kilowatt-hours sold is a significant fact. Load building and a proper balance between lighting and power load form one of the outstanding problems of the industry. By reason of the fact that during the previous years the operating companies of New England had given the proper amount of attention to the building up of the residential load, when the time of industrial inactivity arrived the high-revenue lighting customers were sufficient to keep the industry headed in a forward direction.

The distribution of the central-station load during 1924 was radically different from that in 1923. In 1924 a total of 10,431,000,000 kw.-hr. was used in intracompany business and line losses. This sum was greater than the combined output in 1924 of the West North Central, East South Central, West South Central and Mountain States. In 1923 this non-revenue load totaled 9,827,000,000 kw.-hr., showing an increase of approximately 600,000,000 kw.-hr. for the twelve-month period. In 1924 the lighting load was 30.1 per cent of the total energy consumed by customers, as against 27.3 per cent recorded during 1923. The industrial consumption during 1924 was 55.0 per cent of the total, as against 58.3 per cent in 1923, and the railroads used 14.9 per cent of the total during 1924, as against 14.5 per cent in 1923.

The returns upon which the 1924 operations of the electric light and power systems are estimated indicate that 36.9 per cent of the energy was generated in hydro-electric plants and 63.1 per cent in fuel-burning plants. If the purely electric railway plants, Reclamation Service plants and certain private plants are included as reported monthly by the United States

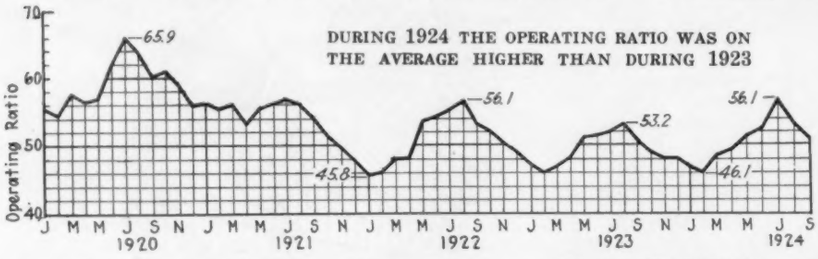
Table III—Operations of Central-Station Hydro and Fuel Power Plants in the United States During 1924*

(100 per Cent of the Industry)

Sections	Energy Generated During 1924				Fuel Consumption		
	Hydro Plants		Fuel Power Plants				
	Thousands of Kw.-Hr.	Per Cent	Thousands of Kw.-Hr.	Per Cent	Coal (Short Tons)	Oil (Barrels)	Gas (Thousands of Cubic Feet)
United States	12,908,400	36.9	34,029,000	63.1	32,478,300	16,389,400	44,093,800
New England	1,453,000	39.8	2,195,000	60.2	1,785,000	1,513,000	0
Middle Atlantic	4,630,000	33.8	9,070,000	66.2	9,075,000	282,500	396,500
South Atlantic	2,165,000	37.9	3,550,000	62.1	3,284,000	1,303,000	1,278,000
East North Central	1,692,000	13.1	11,280,000	86.9	12,920,000	39,900	2,405,000
West North Central	1,147,000	32.6	2,365,000	67.4	3,100,000	1,610,000	3,475,000
East South Central	1,085,000	54.2	918,000	45.8	1,250,000	267,500	116,000
West South Central	11,400	0.6	1,776,000	99.4	445,000	4,365,000	15,700,000
Mountain	2,485,000	87.0	372,000	13.0	572,500	258,500	203,300
Pacific	5,240,000	67.8	2,503,000	32.2	47,300	6,750,000	20,520,000

* Based on data collected by the United States Geological Survey for the first ten months of the year.

Geological Survey, then the estimated output, as given in Table IV, indicates that 34.5 per cent of the total was generated in hydro-electric plants. On the face of the returns, therefore, a continuance of the decrease in the proportional amount of energy generated in hydro-electric plants is indicated. It must be remembered, however, that owing to the severe drought on the Pacific Coast during the spring and summer of last year the amount of hydro-electric energy generated in that water-power section of the country during the year is estimated at 5,236,100,000 kw.-hr., or approximately 644,000,000 kw.-hr. under that generated in the hydro-electric plants of this section during 1923. Had the energy generated by these Western hydro plants been on a par with 1923, the proportionate amount of energy generated by the hydro-electric plants of the country during 1924 would have been approximately 35.6 per cent, indicating an increase in the percentage of energy generated in hydro-electric plants over 1923. It must be remembered that, as indicated in another article appearing elsewhere in this issue, many large hydro plants were put into operation during this period. Moreover, the large industrial centers of the country are very largely supplied by energy from steam-electric plants, and these, owing to the industrial inactivity, experienced a material reduction in industrial load during the year which was not shared to the same extent by the hydro-electric plants. These two facts probably explain the increase in hydro-plant output, if normal water conditions are assumed.



Financially the electric light and power industry posted up a new record during 1924 with a gross revenue from the sale of energy of $1,335,100,000. This is an increase from the sale of energy of $65,550,000, or 5.2 per cent, over 1923. Every section of the country reported an increased revenue. The total operating and maintaining expenses of the industry are estimated at $690,800,000, which is an increase of $34,600,000, or 5.3 per cent, over 1923. As indicated elsewhere in this issue, the industry increased its capitalization by aproximately one billion dollars in the year, making a total capitalization on January 1, 1925, of $6,600,000,000. This figure is based upon the aggregate capitalization of the industry on January 1, 1923, as it was reported by the United States Census Bureau, and new capital that was added during the years 1923 and 1924.

Central-station activity should increase materially during 1925. The industry has had a chance to catch up on new construction, and the year opens with the industrial load on the increase and with every prospect of large industrial activity during the coming months. The industry has weathered the generally inactive year of 1924 magnificently and stands ready to make new records in every line during 1925.

Table IV—Energy Generated in Public Utility Plants During 1923 and 1924

(Includes energy generated by central stations, purely electric railway plants, Reclamation Service plants and certain private plants)

State and Section	1924 (Estimated) Energy Generated in Hydro Plants* (Thousands of Kw.-Hr.)	1924 (Estimated) Energy Generated in Fuel-Burning Plants* (Thousands of Kw.-Hr.)	1924 (Estimated) Total Energy Generated* (Thousands of Kw.-Hr.)	Total Energy Generated in 1923† (Thousands of Kw.-Hr.)
United States	20,219,830	38,453,840	58,673,670	55,674,435
Sections				
New England	1,481,080	2,752,920	4,234,000	4,275,836
Middle Atlantic	4,763,030	11,418,970	16,182,000	15,413,092
East North Central	1,749,600	11,951,400	13,701,000	12,768,916
West North Central	1,182,680	2,721,360	3,904,040	3,975,852
South Atlantic	2,166,750	3,717,950	5,884,700	5,708,223
East South Central	1,087,200	989,100	2,076,300	1,890,000
West South Central	11,410	1,914,640	1,926,050	1,693,367
Mountain	2,541,980	434,600	2,976,580	2,838,915
Pacific	5,236,100	2,552,900	7,789,000	7,110,234
New England				
Maine	445,770	12,230	458,000	452,892
New Hampshire	183,230	40,770	224,000	195,705
Vermont	212,560	3,440	216,000	155,344
Massachusetts	452,000	1,613,000	2,065,000	2,093,161
Rhode Island	7,020	392,980	400,000	517,230
Connecticut	180,500	690,500	871,000	861,504
Middle Atlantic				
New York	4,080,000	5,320,000	9,400,000	8,722,289
New Jersey	2,030	1,279,970	1,282,000	1,250,606
Pennsylvania	681,000	4,819,000	5,500,000	5,440,197
East North Central				
Ohio	39,800	3,620,200	3,660,000	3,587,841
Indiana	81,800	1,194,200	1,276,000	1,261,097
Illinois	205,000	4,435,000	4,640,000	4,070,967
Michigan	768,000	1,957,000	2,725,000	2,580,399
Wisconsin	655,000	745,000	1,400,000	1,268,612
West North Central				
Minnesota	350,500	498,500	849,000	857,931
Iowa	695,000	459,000	1,154,000	1,109,719
Missouri	66,700	857,300	924,000	1,060,976
North Dakota	0	39,440	39,440	36,116
South Dakota	11,280	55,820	67,100	62,053
Nebraska	27,000	308,500	335,500	316,684
Kansas	32,200	502,800	535,000	532,373
South Atlantic				
Delaware	0	85,800	85,800	90,267
Maryland	3,280	458,720	462,000	510,553
Dist. of Columbia	0	313,000	313,000	301,298
Virginia	240,600	504,400	745,000	729,641
West Virginia	23,200	1,751,800	1,775,000	1,710,883
North Carolina	432,000	243,000	675,000	632,317
South Carolina	821,000	49,900	870,900	894,893
Georgia	635,000	107,000	742,000	656,046
Florida	11,670	204,330	216,000	182,325
East South Central				
Kentucky	200	401,800	402,000	352,274
Tennessee	431,500	257,500	689,000	649,484
Alabama	655,500	257,000	912,500	823,216
Mississippi	0	72,800	72,800	65,026
West South Central				
Arkansas	3,280	150,720	154,000	147,675
Louisiana	0	306,000	306,000	282,580
Oklahoma	380	325,670	326,050	290,495
Texas	7,750	1,132,250	1,140,000	972,617
Mountain				
Montana	1,117,610	8,390	1,126,000	1,138,545
Idaho	798,020	1,980	800,000	694,871
Wyoming	11,030	44,720	55,750	48,853
Colorado	218,000	269,500	487,500	461,570
New Mexico	790	19,240	20,030	18,268
Arizona	110,000	47,200	157,200	157,183
Utah	239,000	42,500	281,500	272,577
Nevada	47,530	1,070	48,600	47,048
Pacific				
Washington	1,347,000	120,000	1,467,000	1,446,486
Oregon	448,000	234,000	682,000	594,434
California	3,441,100	2,198,900	5,640,000	5,069,314

* Based upon data for ten months as collected by United States Geological Survey.

† Data collected by United States Geological Survey.

The Engineer's Responsibility

By Farley Osgood

President American Institute of Electrical Engineers

THE engineer may well be proud of the progress made during 1924, for never before in the electrical industry has so much money been invested in a single year. Of course, the principal developments have been in the light and power field, the field of communication and radio, although a great deal of work has been done in electrochemistry as well as along the lines of additional mechanical applications of electrical energy.

In light, power and communication alone more than two billion dollars has been invested during 1924, and the expenditure of these immense sums of money places the engineer in a very serious position. Fairly or unfairly, it has been more than intimated that the engineer has inherently a greater interest in engineering than in the relationship of his results to financing, return on investments, etc.

The lawyer has to determine if the project can be rightfully carried forward. The engineer has to determine if the undertaking can be accomplished physically. The banker has to determine if the money can be raised for the project and if the return to the investor is safe and sufficient. The engineer, by his planning, may or may not meet the requirements of the financial sponsors, and in the present condition of high material and labor costs and the abundance of funds for investment, particularly for electrical projects, the engineer's sense of responsibility and his desire to attain the highest degree of usefulness should make him direct his work to bring about, sanely and safely, the greatest return for the least investment of capital.

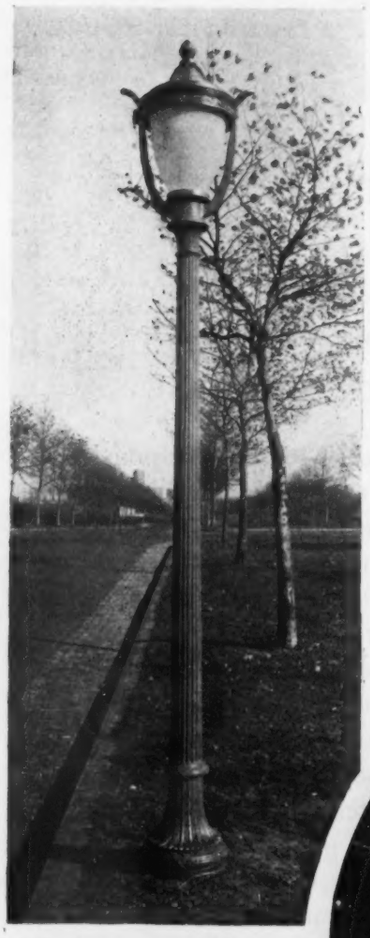
In the earlier days an interruption in the service of applied electrical energy for light, power, communication or what not was, of course, disappointing, but nevertheless expected, owing to the imperfect development of the art; but today there is no greater misfortune than an interruption of any undertaking where electric service is the source of energy and where it must be depended upon. Interruption, in fact, cannot be tolerated.

In their desire for the perfection of service, engineers, through all the evolutionary stages of development, have spared no expense to attain as high a standard of perfection as possible. The time has now come when they must let their minds turn, not away from perfection, which means continuity of service, but toward the means of getting it in a less expensive way. This involves methods, design and construction.

The more the engineer can look at his problems from the viewpoint of the banker and investor, the more rapid will the progress of service be. So let the 1925 signals, displayed from the masthead of the ship "Good Engineering," read: *Performance, Simplicity, Low Cost.*

Street and Highway Lighting

EDUCATIONAL work has at last convinced municipalities that street lighting is an essential part of civic activities. It gives tone to a city and adds to the safety of the citizens. Views of some modern fixtures are shown here, as well as views of typical street and highway lighting installations. Many new installations were made during the year, and several cities are now developing their street lighting on the zone plan and after detailed studies of requirements have been made. A standard boulevard pedestal for Philadelphia in the upper left-hand view and a southern California pedestal in the upper right-hand view show typical designs. At the bottom is a view of Sheridan Road, Chicago, illuminated with "Bi-Lux" units. A typical highway lighting installation on Staten Island, N. Y., using "Novalux" units is shown in the center.



Utility Financing During 1924

Investors Turn Another Billion Dollars of New Money Into the Industry to Finance an Unprecedented Growth as Fresh Provisions Make the Securities Veritable Safety Bulwarks

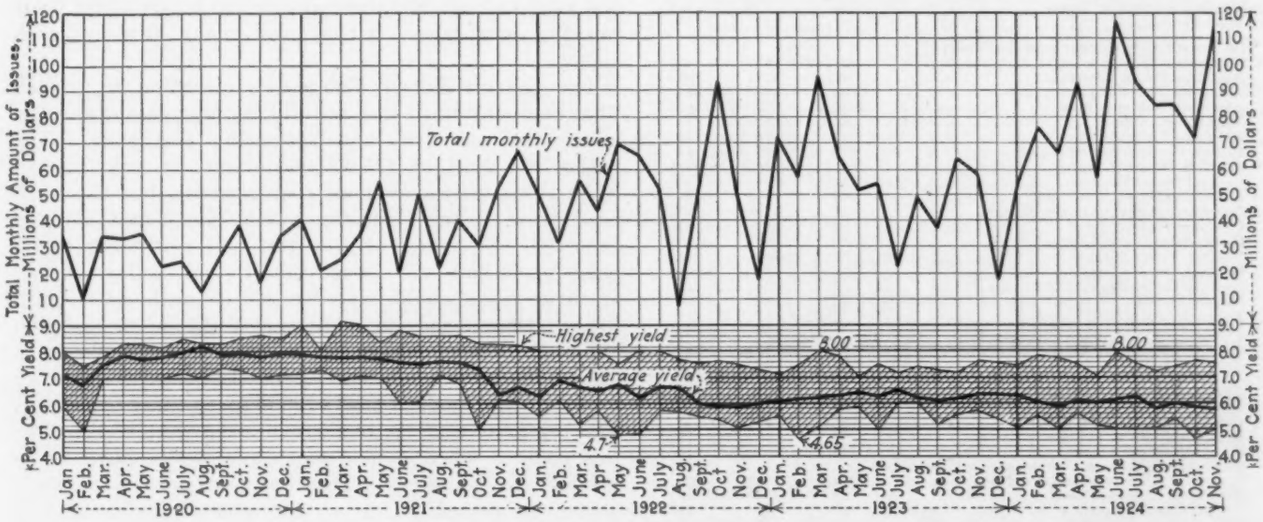
By PAUL WILLARD GARRETT

MORE than a billion dollars in new capital is what investors of this country put into the power and light industry during 1924, or more by $400,000,000 than had ever been invested in any previous year. The figure is exclusive of what went into telephone, electric railway and gas enterprises. Our financial annals contain no chapters more romantic than some added last year in connection with this financing.

Forty years ago, in 1885, our central stations were generating energy at the rate of about 175,000,000 kw.-hr. a year, and the industry was being operated on a capitalization of approximately $55,000,000. Some individual companies now earn more annually than what then was the total capitalization of the industry. The annual total of energy now generated is nearly 54,000,000,000 kw.-hr. The significant thing from the standpoint of those who have been raising capital to finance this growth is that most, say three-quarters, of the growth has come within the last decade. The industry still is in its infancy and, with the demands for energy growing faster than the supply even in the face of general business depression, power and light companies endeavored during 1924 to lay the foundations for financing of a permanent character.

The billion dollars in new capital added during 1924 means that on January 1, 1925, something like $6,600,000,000 was invested in the power and light industry. Counting $5,500,000,000 invested in the electric railways, $3,000,000,000 in telephones and $1,000,000,000 in electrical manufacturing and merchandising concerns, our electrical industry now has a total capitalization of more than $16,000,000,000. The electrical industry already is substantially larger than any other in the country except the railroad industry and, judged by all present indications, will lead them all in a few years.

The seasoning of railroad issues that made them become accepted as our prime corporation investments a generation or so ago began with the great era of railroad expansion. The power and light industry is now in the same sort of an expansion era that the railroads went through years ago, but with this difference, that the period of utility growth and expansion should run longer. Certain things limit pretty definitely the number of carriers that can serve a particular territory. The best engineers have been unable to see any end to the possibilities for the extension of electrical services. Thousands of conservative investors who heretofore had not thought much about the power and light industry are beginning to visualize its possibilities.



AS THE FINANCIAL NEEDS OF THE INDUSTRY HAVE INCREASED THE RATE OF INTEREST PAID HAS DECREASED

THAT MAGIC WORD "SUPERPOWER"

To utility operators the term "superpower" introduces nothing so very new. Interconnections between important parts of different systems already have been installed for some time or have been in the planning. Operators have known pretty well what the possibilities were.

Many of these large "tie-ups" were made during 1924, however, and talked about. As regards the average investor, these "superpower" developments, by dramatizing the industry, have opened his eyes to a heretofore undiscovered field. The creation of a great electrical highway stretching from Cleveland to tidewater, for example, and connecting such systems as the Cleveland Electric Illuminating, American Gas & Electric and American Water Works & Electric, has given the ordinary investor a vision of the industry that he would

never have caught from looking at the incandescent lamp in his office and home. It gave him the same thrill that came when Harriman connected the West with the East by stretching a railroad across the plains.

Mergers of various power and light groups have stimulated the same interest in utilities that was aroused years ago in railroad securities when such systems as the Pennsylvania and New York Central were formed through the consolidation of small properties already in existence.

Approximately $1,175,120,800 in new power and light securities were marketed during 1924; mortgage bonds totaled $672,463,600, debentures $132,875,000, preferred stock sold through investment houses $175,582,200 and local sales of stock to customers roughly $194,200,000.

THE RECORD RISE IN STOCKS OF 1924

	Low 1924	High 1924	Gain from 1924 Low
New York Stock Exchange:			
American Water Works & Electric	40	210*	170
North American	22	45	23
Public Service Corporation of New Jersey	39	69¼	30¼
Utah Securities	16⅛	46	29⅞
Virginia Railway & Power	36	72⅜	36⅜
West Penn	47⅛	122	74⅛
New York Curb Market and Unlisted:			
Adirondack Power & Light	22½	38	15½
American Gas & Electric	43½	123½	80
American Power & Light	198	690†	492
American Public Utilities	35	97	62
Appalachian Power	39	92	53
Arkansas Light & Power	22	70	48
Buffalo General Electric	118	195	77
Carolina Power & Light	82½	340	257½
Central States Electric	20	76	56
Cities Service	140	187	47
Columbus Railway, Power & Light	71	120	49
Commonwealth Power	50	133	83
Continental Gas & Electric	49	98½	49½
Dayton Power & Light	70	180	110
General Gas & Electric	15	80	65
Georgia Light, Power & Railways	9	36	27
Indiana Service	40	90	50
Kentucky Securities	32	87	55
Lehigh Power	31	100	69
Middle West Utilities	41	86	45
Mississippi River Power	18¾	35	16¼
National Power & Light	60	204	144
Northern Ontario Light & Power	17	53	36
Northern Texas Electric	58	84	26
Puget Sound Power & Light	43½	61½	18
Republic Railway & Light	13	51	38
Standard Gas & Electric	27	45	18
Southeastern Power & Light (quoted as the equivalent of Alabama Traction, Light & Power)	24‡	130‡	106
Tennessee Electric Power	20	52½	32½
United Gas & Electric	14	42	28
United Light & Power	30	58	28
Virginia Power	16	70	54
Western Power	23½	46	22½

*The high price of 42 for the new stock, which was exchanged for old on the basis of five to one, is the equivalent of 210 for the stock that sold earlier in the year at 40.

†The high price of 67½ for the new stock, which was exchanged for old on the basis of ten to one, is the equivalent of 672 for the old stock that sold earlier in 1924 at 198.

‡Southeastern Power & Light, which was exchanged on the basis of two to one for Alabama Traction, Light & Power, sold as high as 58. The old Alabama shares earlier in 1924 sold as low 24.

Financial writers and the utilities companies themselves have said more about the notable progress made with the customer-ownership campaigns than about any other phase of the new financing. The reasons are that (1) local sales of stock to customers have done more to establish sound public relations for the industry than anything else and (2) an incalculable benefit has come to all senior issues through the junior financing. But in point of actual volume, of course, the bond financing has been the most important, and it was in connection with the drawing of new mortgages that utility financing during 1924 attained a degree of refinement and perfection that swiftly is making power and light bonds our prime investments outside of the government group.

Generally when corporations need new money their primary concern is to get the funds immediately needed at the most advantageous rate and through issuance of the most expedient instrument. Any one accustomed to this school of financing must have been impressed with almost every important loan conference held last year between the utilities and the investment bankers. A discussion of plans to raise new funds for immediate use almost invariably raised the question of future financing. Shall we issue bonds under our present mortgage? If we do, where will it lead us in ten years? Would not the company be benefited in the long run by the creation of a new modern or self-refunding mortgage?

A MOVE TO OPEN-END MORTGAGES

The old-style public utility mortgage was drawn up on lines similar to the typical railroad or industrial mortgage. In creating a lien on its entire property as the basis for a forty-million-dollar loan, for example, a first mortgage was created with bonds authorized to some amount in excess of the total to be sold immediately. The limit may have been placed at $100,000,000, we will say. Not many power and light companies last year had reached their authorized totals under their working mortgages, but a good many foresaw such a day.

The Detroit Edison Company's situation is typical. That company until last fall did its mortgage financing under the old first and refunding mortgage. The authorized limit of $75,000,000 originally was thought to be sufficient to cover all requirements, but the business grew faster than the management and bankers expected. So many of the first and refunding mortgage bonds had been issued that Detroit Edison in two or three years would have reached its authorized limit. Rather than issue its additional $12,500,000 last fall under the old mortgage, as it easily could have done, letting the future take care of itself, Detroit Edison set up a new and modern mortgage before selling the bonds. The company and its bankers figured that if the time was coming when a new mortgage would have to be created the sooner a permanent mortgage was established the better. That is, the smaller the volume of underlying bonds, the better it would be for the new mortgage bonds.

Contrary to common opinion, bondholders are better protected under the ideal modern mortgage which contains no authorized limitation than under the typical old-style mortgages. Where is the protection in a mortgage authorized to the amount of $100,000,000 if a company's valuation, earnings and structure justify only $60,000,000 in bonds at a particular time? In eliminating the arbitrary limit the modern mortgage makes the issuance of bonds contingent upon certain things that are a true index of the situation. The mortgage is open, but a company cannot borrow in excess of 75 or 80 per cent of the amount to be expended in a new plant, for example, and unless earnings have been running at a rate (after deduction of the proper charges) sufficient to cover interest about one and three-quarters times on all bonds presently to be outstanding.

Usually it is possible under the new mortgages to issue bonds in different series and with different coupon rates. Under its old mortgage Detroit Edison was obliged to make all of its first and refunding mortgage bonds mature in 1940, a provision that may prove to have been unfortunate if 1940 happens to be a year of dear money. Under its new general and refunding

mortgage different series of bonds may be made to mature at various times.

Apart from the tendency during 1924 to replace old mortgages with modern, companies in many instances took advantage of changes in their own credit standing and of the easy money situation to refund high-coupon bonds with lower. The Puget Sound Power & Light Company in June floated a twenty-million-dollar issue of first and refunding mortgage 5½ per cent bonds of 1949 through the creation of an entirely new mortgage. The funds were used in part to redeem general and refunding mortgage 7½ per cent bonds of 1941. On $13,746,500 in par value, the amount of 7½'s previously outstanding, substitution of the 5½ per cent rate effected an annual saving of $269,530. The Idaho Power Company did a still more advantageous piece of refunding. It refunded its old 8 per cent bonds through flotation of 5's.

Companies generally were able to borrow more cheaply that at any time in recent years—a thing that is strikingly brought out by the accompanying tabulation showing that virtually all mortgage bonds sold at prices to yield less than 6.75 per cent and more than half of them sold at levels to yield less than 6 per cent.

Although a more general appreciation of power and light bonds gradually is making them dearer, they still are available at prices which appear cheap in comparison with other groups. Some investors wonder why, if gilt-edged utility bonds are as safe as our best-grade railroad bonds, the utilities sell cheaper. The reason is not hard to find. Railroad bonds, being legal for investment by savings banks in most states, are sought in enormous blocks by our large institutional investors. Many insurance companies are swelling their proportions of public utility bonds, and many savings banks would like to. Some states already have made public utility bonds legal for savings-bank investment. If they were "legal" in a state like New York, for example, as eventually they will be, the market quotations for certain issues would be higher.

No Wallingford tale has more romance than may be found in accounts of 1924's great advance in power and light common stocks. American Power & Light Company's new common stock, which was exchanged for the old stock on the basis of ten to one, recently reached 68, the equivalent of 680 for the old stock, which sold earlier in 1924 at 198. American Water Works & Electric Company's new common stock, which was exchanged for old on the basis of five to one, recently touched 42, the equivalent of 210 for the old stock, which sold earlier in 1924 at 40. North American common ran from 22 to 45. American Gas & Electric common, stimulated by a 50 per cent stock dividend, moved from 43½ to 120. Carolina Power & Light ran from 82 to 345. Commonwealth Power Corporation common increased in value from 50 to 133. Southeastern Power & Light common, which was exchanged for Alabama Traction, Light & Power common on the basis of two to one, recently touched 65, the equivalent of 130 for the stock that sold earlier in 1924 as low as 24. National Power & Light gained in market position from 60 to 205. Dozens of issues doubled in value within the twelve-month period, as may be seen from examples in the accompanying table.

While the stocks in many instances were whirled forward by pool operations at a rate faster than they normally would have moved, the interesting point is that they have held their ground pretty well all of the way up. Investors who fear that the spectacular forward movement in the equity issues suddenly will collapse lose sight of the fact that the rise has had a sound basis. Power and light stockholders have had long years of waiting for dividends on the common issues. For the large sums that have been plowed back into the properties over a period of years, when the common stockholders were receiving no dividends in most instances, or very small dividends, the properties heretofore have borne little fruit. Apparently we are entering an era in which the common-stock holder will get back the return on his investment for which he has waited so long. Within another year, the indications are, many stocks that never had a dividend will receive

ELECTRIC LIGHT AND POWER SECURITY ISSUES IN 1924

Public Sales by Investment Houses

	Amount of Issue	
MORTAGE BONDS (average yield 6.00 per cent):		
25 issues yielding from 5.00 to 5.50 per cent...	$111,916,100	
15 issues yielding from 5.55 to 5.65 per cent...	64,828,000	
21 issues yielding from 5.70 to 5.78 per cent...	111,152,000	
26 issues yielding from 5.80 to 6.00 per cent...	71,183,000	
19 issues yielding from 6.03 to 6.15 per cent...	76,669,000	
16 issues yielding from 6.18 to 6.25 per cent...	31,623,500	
20 issues yielding from 6.30 to 6.40 per cent...	83,285,000	
29 issues yielding from 6.50 to 6.65 per cent...	69,102,000	
18 issues yielding from 6.70 to 6.94 per cent...	34,405,000	
12 issues yielding from 7.00 to 7.65 per cent...	18,300,000	
201 issues		$672,463,600
DEBENTURES (average yield 6.25 per cent):		
2 issues yielding from 4.70 to 4.80 per cent...	$9,000,000	
9 issues yielding from 5.00 to 5.75 per cent...	27,700,000	
10 issues yielding from 6.00 to 6.49 per cent...	26,200,000	
11 issues yielding from 6.50 to 6.90 per cent...	28,675,000	
11 issues yielding from 7.00 to 7.27 per cent...	41,300,000	
43 issues		$132,875,000
PREFERRED STOCK (average yield 7.01 per cent):		
2 issues yielding 5.80 to 5.88 per cent.....	$5,100,000	
6 issues yielding from 6.00 to 6.67 per cent...	52,000,000	
11 issues yielding from 6.75 to 7.00 per cent...	43,638,700	
14 issues yielding from 7.04 to 7.14 per cent...	15,26_,000	
10 issues yielding from 7.15 to 7.25 per cent...	11,717,000	
8 issues yielding from 7.33 to 7.50 per cent...	26,022,500	
13 issues yielding from 7.57 to 8.00 per cent...	21,893,000	
64 issues		$175,582,200
Total of all issues of year		$980,920,800
Estimated local sales to customers		194,200,000
		$1,175,120,800

an initial payment or come within sight of a dividend. Therein lies the perfectly sound basis for the sudden marking up of power and light stocks.

To far-sighted investors the brisk rise during 1924 in power and light common stocks should call attention emphatically to the list of preferred stocks. In the feverish markets at times for common stocks and the gradual improvement in bonds the preferred stocks of many companies have been neglected. The time is coming, it would appear, when the better preferred stocks will be selling more in line with our railroad preferred stocks and on a substantially better level.

As a matter of fact, the preferred stocks of our power and light companies have a better record than most people realize. During different periods of stress in the last decade some companies have been obliged to postpone payment of their preferred dividends, but the back accumulations generally have been made up so that most of our important power and light preferred stocks now are receiving dividends regularly. The fact that virtually all of these stocks are entitled to cumulative dividends differentiates them in a measure from railroad preferred stocks, of which relatively few have the cumulative feature. Two things are destined to raise the investment value of power and light stocks, the general improvement in the earning position of the companies and the wide distribution of preferred stock issues that is being accomplished through customer-ownership campaigns.

Distribution of Hydro-Electric Development in the United States

This map, which was prepared by the Federal Power Commission, brings out the amount of large construction which has been undertaken under government authorization since the passage of the federal water-power act. This activity has taken place in practically every section of the country. The size of the respective projects is indicated by the diameter of the circles.

One Billion for New Construction

Record Steam and Hydro-Electric Development Under Way During 1924—Large Plants Spring Up in the Industrial Regions—Extensive Additions to Transmission Systems in Every Part of the Country

THE year which has just closed has witnessed the greatest amount of new capital investment in the history of the industry. As indicated elsewhere in this issue, the electric light and power industry has raised a total of approximately a billion dollars during 1924 for extensions and additions to its generating and distributing equipment. With the expenditure of approximately seven hundred and fifty million dollars during 1923 for extensions and additions, it was thought that the maximum need for extensions had been reached, but the borrowings of central-station companies during 1924 proved this surmise to be in error. The great increase in the load reported for 1923, during which more than two million new customers were added to the lines, evidently brought the peak load of a large proportion of the generating companies to a point very closely approximating the rating of their equipment. The fact that 1924 has been a year of comparatively small peak-load increase for the industry has perhaps not been without its points of value. It has enabled the generating and distributing companies to catch up on new construction and to strengthen the perhaps too-hastily placed equipment of 1923. All industry has certain limits of growth which if exceeded will result in defects of organization and equipment that must be repaired and perfected in periods of slackened growth.

Industry Relieving the Excessive Load

The electric light and power industry during 1924 has been catching up with itself, as it were. The extensive expenditures made during the year, coupled with the fact that 1924 witnessed a subnormal growth, make it very probable that the opening of 1925 finds the industry better able to care for future expansion than at any time since the pre-war period.

In the accompanying tables will be found data on the steam and hydro-electric plants now under construction or completed during the year, some of the outstanding transmission and distribution extensions and the activities of the Federal Power Commission to November 1, 1924. The list of new plants under construction, while probably not complete, is none the less indicative of the great expansion made during the year and that which will take place in the year just opening.

Outstanding Steam-Electric Construction

The year 1924 has witnessed the construction of a number of large steam-electric generating plants. The first 50,000-kw. turbo-generator of the 300,000-kw. Trenton Channel plant of the Detroit Edison Company was put into commission on July 31. A second 50,000-kw. turbo-generator was put on the lines in September and a third 50,000-kw. unit is now being installed and will be ready for commission in February.

The rapidly increasing demand occasioned by the normal growth of population and industry and by the increasing use of electricity forced the Brooklyn Edison Company to add to its total generating capacity of 190,000 kw. by the erection of a station, known as the Hudson Avenue station, which will have an ultimate rating of 400,000 kw., consisting of eight units of 50,000 kw. each, the first of which went into commission on May 1 of last year. The plans are for a virtually continuous program of installation until the whole plant is completed.

The Hell Gate station of the New York Edison Company, which was placed in commission on January 1, 1922, is being completed and the remaining electrical apparatus is being manufactured. The ultimate capacity of this plant will be 335,000 kw.

Within the last two months the announcement has been made of the coming erection of a 300,000-kw. steam-electric plant at Avon, near Cleveland, by the Cleveland Electric Illuminating Company. The initial installation of this station will be 67,500 kw. The plant will be equipped to burn pulverized fuel.

Other outstanding steam-electric developments under construction in the past year are the new Richmond station of the Philadelphia Electric Company, with an ultimate development of 750,000 kva., of which the first 250,000 kva. will be put into operation during 1925; the new Fourteenth Street station of the New York Edison Company, with an ultimate installation of 700,000 kva.; the Philo (Ohio) station of the American Gas & Electric Company, ultimately to be rated at 300,000 kva.; the Crawford Avenue station of the Commonwealth Edison Company, ultimate capacity 600,000 kva., and the Long Beach plant of the Southern California Edison Company, where 100,000 kw. will eventually be installed.

Extensive Hydro-Electric Development in 1924

Nation-wide activity in the development of the nation's water powers has prevailed during the past year, and a large proportion of this construction will extend into 1925. Virtually every section of the country either has extensions under way at the present time or has completed developments during 1924. Thirty-six projects operating under licenses from the Federal Power Commission were completed in 1924 or were under construction on November 1. These projects involve an ultimate installation of 2,360,590 hp., at an estimated cost of $219,898,090.

Of the water-power projects not being constructed under the regulations of the Federal Power Commission, the Muscle Shoals development is the outstanding example. The Wilson Dam will be completed by the government engineers next summer, before which time some arrangement will, it is hoped, be reached by Congress as to the disposition of the completed project. The 210,000 hp. additional installation at Niagara Falls under license from the Federal Power Commission was completed last summer at a cost of $5,494,000. The largest water-power project now under construction is that of the Southern California Edison Company on

Table I—Steam-Electric Generating Plants East of the Rockies Completed in 1924, Now Under Construction or for Which Plans for an Early Start Are Made

Name of Company	Plant	Initial Kva.	Ultimate Kva.	Date of Operation
New England States				
Maine:				
Cumberland Cy. Pr. & Lt. Co.	Portland	*15,600	.....	1924
Massachusetts:				
Montaup Electric Co.	Fall River	30,000	150,000	1924
Middle Atlantic States				
New York:				
United Elec. Lt. & Power Co.	Hell Gate	294,000	419,000	....
Brooklyn Edison Co.	Hudson Street	187,500	500,000	1924
New York Edison Co.	Waterside	37,500	.....	1924
New York Edison Co.	Fourteenth St.	120,000	700,000	1925–26
Utica Gas & Electric Co.	Harbor Point	47,500	187,500	1925
Adirondack Pr. & Light Corp.	Amsterdam	37,500	253,000	1924
Staten Island Edison Corp.	Livingston	*18,800	75,000	1925
New Jersey:				
Public Ser. Elec. & Gas Co.	Kearny	250,000	500,000	....
	Essex	*100,000	.....	1924
Pennsylvania:				
Penn Central Power Co.	Saxton	25,000	80,000	1924
Duquesne Light Co.	Colfax	*70,000	150,000	1924
	Beaver	.....	375,000	....
Philadelphia Electric Co.	Richmond	250,000	750,000	1925
Holtwood Power Co.	Holtwood	28,100	150,000	....
Metropolitan Edison Co.	Middletown	37,500	250,000	1924
Citizens Traction Co.	Riverside	7,500	.....	1925
Luzerne County Gas & El. Co.	Luzerne Co.	25,000	125,000	....
West Penn Power Co.	Springdale	*70,000	.....	1924
South Atlantic States				
Maryland:				
Cons. Gas, El. Lt. & Power Co.	Westport	*51,500	.....	1924
	Gould Street	56,300	.....	1925
Virginia:				
Danville Municipal		9,400	.....	1924
West Virginia:				
Cons. Lt., Heat & Power Co.	Kenova	15,000	.....	1924
North Carolina:				
Carolina Power & Light Co.	Cape Fear	*18,700	75,000	1924
Southern Power Co.	Tiger	37,500	37,500	1924
	Mt. Holly	40,000	.....	1924
	Eno	20,000	.....	1924
South Carolina:				
Southern Power Co.	Duncan	37,500	37,500	1924
W. S. Barstow & Co.	Parr Shoals	....	14,000	1925
Potomac Electric Power Co.		*25,000	.....	1924
Florida:				
Florida Power & Light Co.	Miami Beach	*6,200	10,600	1925
Jacksonville Municipal	Talleyrand	48,300	.....	1924
Miami Electric Light & Pr. Co.		33,300	84,400	1925
East North Central States				
Ohio:				
Cleveland Electric Illum. Co.	Avon	84,000	375,000	....
	Lakeside	*28,000	.....	1924
Union Gas & Electric Co.	Cincinnati	*30,000	.....	1926
Columbia Power Co.	Miami Fort	100,000	375,000	1925
American Gas & Elec. Co.	Philo	60,000	300,000	1924
Pennsylvania-Ohio Edison Co.	Toronto	66,000	240,000	1924
Indiana:				
American Public Utilities Co.	Wabash River	75,000	125,000	1924
Indiana & Michigan Elec. Co.	South Bend	60,000	300,000	1925
Illinois:				
Central Illinois Pub. Ser. Co.	Grand Tower	48,800	.....	1924
Pub. Ser. Co. of Northern Ill.	Joliet	37,500	.....	1924
Illinois Electric Power Co.	Peoria	50,000	125,000	....
Tri-City Railway & Light Co.	Moline	*26,000	.....	1924
Illinois Power & Light Co.	Venice	*20,000	.....	1924
Danville St. Ry. & Light Co.	Danville	7,500	.....	1924
Commonwealth Edison Co.	Crawford Ave.	160,000	600,000	1924
Michigan:				
Detroit Edison Co.	Trenton Channel	187,500	375,000	1924–25
Detroit Municipal	Detroit	80,000	.....	1925
Wisconsin:				
Milwaukee El. Ry. & Light Co.	Lakeside	37,500	250,000	1924
West North Central States				
Minnesota:				
Northern States Power Co.	High Bridge	75,000	187,500	1924
	Riverside	*30,000	*90,000	1926
St. Paul Gas Light Co.	Island	25,000	25,000	1924
Owatonna Municipal		1,200	5,000	1925
Faribault Municipal		1,900	5,000	1926
Iowa:				
Sioux City Gas & Electric Co.	Big Sioux Station	25,000	75,000	1925
Muscatine Municipal		1,900	7,500	1924
Iowa Power & Light Co.	Bull's Ford	60,000	167,500	1925
United Light & Railways Co.	Davenport	26,000	150,000	1924
Missouri:				
Empire District Electric Co.	Joplin	*18,800	.....	1925
Kansas City Pr. & Light Co.	Northeast	*37,500	300,000	1924
North Dakota:				
Union Light, Heat & Pr. Co.	Fargo	4,000	.....	1924
South Dakota:				
Redfield Municipal		500	1,250	1925
Kansas:				
Kansas Power & Light Co.	Tecumseh	15,000	75,000	1925
Kansas Gas & Electric Co.	Service City	60,000	.....	1924
Topeka Edison Co.	Topeka	15,000	.....	1924
East South Central States				
Kentucky:				
Kentucky Utilities Co.	Pineville	37,500	37,500	1924
Tennessee:				
Memphis Power & Light Co.	Fourth Street	*25,000	.....	1925
Tennessee Electric Power Co.	Hale's Bar	56,200	112,500	1924
West South Central States				
Louisiana:				
New Orleans Pub. Service, Inc.	Market Street	*25,000	.....	1925
Southwestern Gas & Elec. Co.	Shreveport	12,500	62,500	1925
Arkansas Light & Power Co.	Sterlington	94,000	154,000	1925
Oklahoma:				
Oklahoma Gas & Electric Co.	Riverbank	28,100	.....	1924
	Horseshoe Lake	18,750	37,500	1924
Texas:				
Oil Belt Power Co.	Leon	*7,500	22,500	1925
Dallas Power & Light Co.	Dallas	*25,000	75,000	1924
Houston Lighting & Power Co.	Deepwater	50,000	22,500	1924
Arkansas:				
Arkansas Light & Power Co.	Pine Bl. Pr. Sta.	*3,750	14,000	1924
	El Dorado	.....	*2,800	1924

*Additional extensions.

Table III—Hydro and Steam-Electric Developments in the Mountain and Pacific States

Name of Company	Name of Plant	Location	Estimated Cost*	Prime Movers
Idaho Power Co.	American Falls	American Falls Snake River, Idaho	$2,800,000	2 vertical Allis-Chalmers, 9,000-hp. each
Washington Water Pwr. Co.	Oroville	Similkameen River, Wash.	750,000	2—500-hp. horizontal double-runner Pelton
	Long Lake	Spokane River, Wash.	14,100,000	1—22,500-hp. horizontal double-runner I. P. Morris
City of Seattle	Gorge plant	Skagit River, Wash.	8,400,000	2—28,000-hp. single-runner vertical reaction, S. Morgan Smith
Southern California Edison Co.	Long Beach steam plant No. 2	Long Beach, Cal.	7,467,000	2—35,000-kw., G.E. turbines
	Long Beach steam plant No. 1	Long Beach, Cal.	5,010,000	2—6,000-kw. G.E.; 1—10,000-kw. A.C.
	Big Creek No. 1	Big Creek, Cal.	6,400,000	1—35,000-hp., Pelton impulse
	Big Creek No. 2	Big Creek, Cal.	6,400,000	1—20,000-hp., Pelton impulse
Turlock Irrigation District	Grange plant	Tuolumne River, Cal.	800,000	.....
Northwestern Electric Co.	Yale	Lewis River, Wash.	6,000,000	2—20,000-hp., Francis type
Western States Gas & Elec. Co.	El Dorado	American River, Cal.	4,000,000	2—14,000-hp., Allis-Chalmers
Utah Power & Light Co.	Soda Springs	Bear River, Utah	2,800,000	2—10,000-hp. vertical, Allis-Chalmers
City of San Francisco	Moccasin Creek	Tuolumne River, Cal.	12,800,000	4—25,000-hp., Pelton impulse
Los Angeles Gas & Electric Corp.	Los Angeles steam plant	Los Angeles, Cal.	7,903,000	1—23,457-hp. turbine
	Seal Beach steam plant	Seal Beach, Cal.	3,200,000	1—48,000-hp. turbine
British Columbia Electric Railway Co.	Stave Falls	Stave Falls, B. C.	8,400,000	1—15,000-hp., Canadian Allis-Chalmers
Portland Electric Power Co.	Oak Grove	Clackamas River, Ore.	5,100,000	1—35,000-hp. reaction, Pelton
Southern Sierras Power Co.	Leevining Creek No. 1	Owens River, Cal.	2,000,000	1—14,000-hp., Pelton
	Adams main plant	Owens River, Cal.	1,000,000	1—7,500-hp., Worthington
Great Western Power Co.	Caribou	American River, Cal.	27,000,000	2—15,000-hp., Allis-Chalmers
Pacific Gas & Electric Co.	Pit River No. 3	Pit River, Cal.	12,960,000	3—33,000-hp., Pelton
Public Service Company of Colorado.	Lakeside steam plant	Near Boulder, Colo.	2,133,000	1—33,500-hp. turbine
Joaquin Light & Power Corp.	Balch	Kings River, Cal.	6,000,000	2—20,000-hp., impulse
City of Tacoma, Wash.	Cushman P. H. No.	Lake Cushman, Wash.	6,400,000	2—25,000-hp., Allis-Chalmers
Puget Sound Power & Light Co.	Baker River No. 1	Baker River, Wash.	6,240,000	2—20,000-hp., Allis-Chalmers
	White River	White River, Wash.	11,400,000	1—23,000-hp., Allis-Chalmers
California Oregon Power Co.	Copco No. 2	Klamath River, Cal.	4,800,000	2—20,000-hp., Allis-Chalmers
	East Side	Klamath Falls, Ore.	320,000	1—4,250-hp., Allis-Chalmers
Salt River Valley Water Users' Assoc.	Roosevelt	Salt River, Ariz.	3,643,500	1—10,000-hp., Allis-Chalmers
	Horse Mesa	Salt River, Ariz.	6,876,000	3—15,280-hp., S. Morgan Smith
Montana Power Co.	Mystic Lake	Near Columbus, Mont.	2,000,000	2—7,500-hp., Pelton
Utah Power & Light Co.	Culler Plant	Bear River, Utah	5,500,000	2—21,000 hp.
City of Pasadena	Glenn St. Station	Pasadena, Calif.	1,067,000	1—10,000 kw. Allis-Chalmers

*Estimated by ELECTRICAL WORLD based on cost of $150 per horsepower for

the San Joaquin River. The ultimate installation of this development is given as 545,000 hp. and the estimated cost as $67,152,000. This project is scheduled for completion in 1935.

The activities of the Federal Power Commission in 1924 were extensive. On November 1, 1924, a total of 550 applications for permits and licenses had been filed with the commission. During the year projects

Table II—Hydro-Electric Generating Plants East of the Rockies Completed in 1924, Now Under Construction or for Which Plans for an Early Start Are Made

Name of Company	Plant	Initial Kva.	Ultimate Kva.	Date of Operation
New England				
Massachusetts:				
Holyoke Water Power Co.	Conn. River No. 2	*†2,400 *4,000	.....	1925
New England Power Co.	Davis Bridge	40,000	60,000	1924
Middle Atlantic States				
New York:				
Niagara Falls Power Co.	Station 3-C	*140,000	210,000	1924
Watertown Municipal		5,000	7,500	1925
Moreau Manufacturing Co.	Feeder Dam	7,500	10,500	1924
New York State	Crescent Dam.. Vischers Ferry..	16,000	.....	1925
Power Corp. of New York	Herring	10,000	.....	1924
Adirondack Pr. & Light Corp.	Beardslee Falls	20,000	30,000	1924
	Spier Falls	*9,000	72,000	1924
	Sprite Creek	6,000	6,000	1924
Northern New York Utilities	Soft Maple	18,750	28,125	1925
	Sewell's Island	2,500	2,500	1925
Pennsylvania:				
Pennsylvania Pub. Serv. Corp.	Piney	22,000	144,000	1924
Pennsylvania Water & Pr. Co.	Holtwood	*40,000	150,000	1924
South Atlantic States				
Maryland:				
Pennsylvania Pub. Serv. Corp.	Deep Creek	22,000	44,000	1925
Virginia:				
Roanoke Rapids Power Co.		3,200	.....	1924
North Carolina:				
Andrews-Municipal		1,500	2,250	1924
Blue Ridge Power Co.	Turner Station	10,000	15,000	1924
Western Carolina Power Co.	Rhodhiss	42,000	42,000	1925
Tallassee Power Co.	Badin	*35,000	.....	1924
South Carolina:				
Southern Power Co.	Catawba	50,000	80,000	1924
Wateree Power Co.	New Catawba	80,000	80,000	1926
Georgia:				
Georgia Railway & Power Co.	Tugaloo	.....	75,000	1924
	Morgan Falls	.....	22,500	1924
White Water Power Co.	White Water Cr.	.....	.....	1924
Columbus Electric & Pr. Co.	Bartlett's Ferry	50,000	100,000	1926
Augusta-Aiken Ry. & Elec. Corp.	Stevens Creek	*3,125	31,250	1925
East North Central States				
Indiana:				
Indiana Hydro-Elec. Pr. Co.	Oakdale	14,000	.....	1925
Michigan:				
Detroit Edison Co.	French Landing	3,200	3,200	1925
Great Lakes Power Co.	Caro	†250	†450	1924
Village of Bellaire		†150	†225	1925
Alpena Power Co.	Norway Point	4,800	4,800	1924
Wisconsin:				
Wis. Public Service Corp.	Caldron Falls	9,300	9,300	1925
Lake Superior District Pr. Co.	Big Falls	*4,000	.....	1924
Wisconsin Valley Electric Co.	Alexander Dam	5,600	.....	1924
Lake Superior Dist. Electric Co.	Ashland	.....	*7,000	....
West North Central States				
Minnesota:				
Minnesota Power & Light Co.	Fond du Lac	†12,000	†24,000	1924
	Blanchard	†12,000	†18,000	1925
Northern States Power Co.	Red Lake Falls	800	800	1924
	Twin Cities	5,000	10,000	1925
Iowa:				
Northeastern Iowa Power Co.	Cedar River	.....	.....	1925
Citizens Gas & Electric Co.	Waterloo	1,100	.....	1924
Kansas:				
Empire District Electric Co.	Table Rock	60,000	.....	1925
East South Central States				
Kentucky:				
Kentucky Hydro-Electric Co.	Dix Dam	36,000	36,000	1925
Tennessee:				
Tennessee Electric Power Co.	Great Falls	22,200	34,200	1924
	Morganton	18,000	18,000	1927
	Ocoee No. 3	30,000	30,000	1928
Alabama:				
Alabama Power Co.	Upper Tallassee	8,500	60,000	1924
	Lower Tallassee	10,600	75,000	1924
	Cherokee	90,000	180,000	1926
United States Government	Muscle Shoals	250,000	600,000	1925
West South Central States				
Arkansas:				
Arkansas Light & Power Co.	Remmel	18,000	25,000	1924
Arkansas Light & Power Co.	Ouachita	15,000	120,000	1924
Canada				
British Col. Elec. Ry. Co., Ltd.	Alouette	†8,000	†8,000	1926
East Kootenay Power Co., Ltd.	Elko	15,000	15,000	1924
Hydro-Elec. Comm. of Ontario.	Queenston	*260,000	.....	1924
	Trent Dam No. 8.	6,600	6,600	1924
	Trent Dam No. 9.	4,800	4,800	1925
	South Falls	*4,400	.....	1924
	Nipissing	*1,300	.....	1924
	Nipigon	*50,000	.....	1924
	Bingham Chute	1,300	1,300	1925
Northern Canada Power, Ltd.	Quinze	20,000	60,000	1924
Nova Scotia Power Comm.	Malay Falls	5,550	.....	1924
	Ruth Falls	6,000	.....	1925
Quebec Development Co., Ltd.	Isle Maligne	360,000	540,000	1925
Winnipeg Municipal		15,000	30,000	1924
Manitoba Power Co.	Great Falls	*28,000	168,000	1924
Hollinger Consol. Gold M., Inc.	Island Falls	25,000	.....	1924
Montreal Lt., Heat & Pr. Cons.	Cedars	*22,600	200,000	1924
St. Maurice Power Co.	La Gabelle	100,000	120,000	1924
Southern Canada Power Co.	Hemming Falls	33,600	37,800	1925
Ottawa River Power Co.	Calumet Falls	22,500	75,000	1925
Hull Electric Co.	Paughan Falls	.....	100,000	
Laurentian Hydro Electric Co.	North River	.....	14,000	1924
Price Bros. & Co., Ltd.	Chicoutini	11,000	.....	1924
Newfoundland				
Newfoundland Pr. & Pulp Co.	Humber River	118,000	.....	1925

* Additions and extensions. † Kilowatts.

...tates and Western Canada Completed or Under Construction During 1924

Generators	Effective Head Ft.	Initial Capacity	Ultimate Capacity	Date of Completion	Remarks Status of Development
...2—7,500-kva. vertical, Allis-Chalmers	45—50	17,500-kva.	Indefinite	1924	Covers addition of two 7,500-kva. units during 1924.
...1—1,600-kw. horizontal, G.E.	80	5,000-hp.	5,000-hp.	1924	Covers second unit.
...1—17,500-kw. horizontal, G.E.	172	94,000-hp.	94,000-hp.	1924	Covers fourth unit.
...2—30,000-kva., Westinghouse	275	56,000-hp.	114,000-hp.	1924	First development on Skagit River.
...2—35,000-kw.		70,000-kw.	70,000-kw.	First unit 1924	Second unit to be completed Feb. 1925.
...2—6,000-kw.; 1—10,000-kw.		47,000-kw.	69,000-kw.	1924	Emergency installation on account of dry year.
...1—25,000-kw., Westinghouse	2,000 (approx.)	2—16,000-kw.	73,000-kw.	July 1, 1925	Now under construction.
...1—16,000-kw., Westinghouse	1,800 (approx.)	2—16,000-kw.	64,000-kw.	May 1, 1925	Now under construction.
...1—4,000-kw.		4,000-kw.		During 1925	Now under construction.
...2—18,000-kva.	140	30,000-kw.	45,000-kw.	Jan. 1, 1926	Construction just starting.
...2—10,000-kw., G.E.	1,750	20,000-kw.	75,000-kw.	First dev. Jan., 1924	
...1—7,000-kw., G.E.	76	14,000-kw.	14,000-kw.	Oct., 1924	
...4—20,000-kva., G.E.	1,250	80,000-kva.	120,000-kva.	March, 1925	Work practically completed.
...1—23,457-hp.			98,787-hp.	1924	Covers installation of additional unit in existing plant.
...1—40,000-hp., Westinghouse		40,000-hp.	288,000-hp.	July, 1925	Now under construction.
...1—13,125-kva., Canadian G. E.	113		52,500-kva.	April, 1925	Covers inst. of fifth unit in existing plant; now under construction.
...4—30,000-kva., GE	860	25,500-kw.	76,500-kw.	Aug., 1924	
...4—12,500-kva., G.E.	1,531	12,500-kva.	12,500-kva.	1924	
...1—6,250-kva., G.E.	221	6,250-kva.	6,250-kva.	1924	
...6—22,223-kva., G.E.	1,074		135,000-kw.	1924	
...3—27,000-kva.	280	81,000-kva.	81,000-kva.	July, 1925	Cost about $13,000,000, work two-thirds completed.
...1—25,000-kva., Westinghouse		20,000-kw.	100,000-kw.	Dec., 1924	Practically completed.
...8—28,250-kva.	2,312	40,000-hp.	240,000-hp.	1926	Construction under way.
...2—20,000-kva., Allis-Chalmers	250	40,000-kva.	40,000-kva.	1925	Construction under way.
...4—19,500-kva., G.E.	228	39,000-kva.	79,000-kva.	Fall of 1925	Now under construction.
...2—20,000-kva., G.E.	440		57,000-kw.	Nov., 1924	Covers installation of fourth unit.
...4—15,000-kva., Westinghouse	140	30,000-kva.	30,000-kva.	May, 1925	Work one-fourth completed.
...1—4,000-kva., Allis-Chalmers	45	4,000-kva.	4,000-kva.	Aug., 1924	Work completed.
...3—7,500-kva.	90—240		24,290-hp.	Nov., 1924	Work completed.
...4—11,100-kva., G.E.	264	45,840-hp.	45,840-hp.		Proposed plant equipment partly ordered.
...4—4,250-kva., Westinghouse	1,050	10,000-kw.	10,000-kw.	Early in 1925	Work nearly completed.
...1—15,000-kva.	128	30,000-kva.		1926	Work to begin March 1, 1925
...2—12,500-kva., Allis-Chalmers		10,000-kw.	25,000-kw.	1924	Addition to existing steam plant.

...hydro-electric developments and $80 per horsepower for steam-electric plants.

Table IV—High-Tension Transmission Lines Completed and Under Construction During 1924

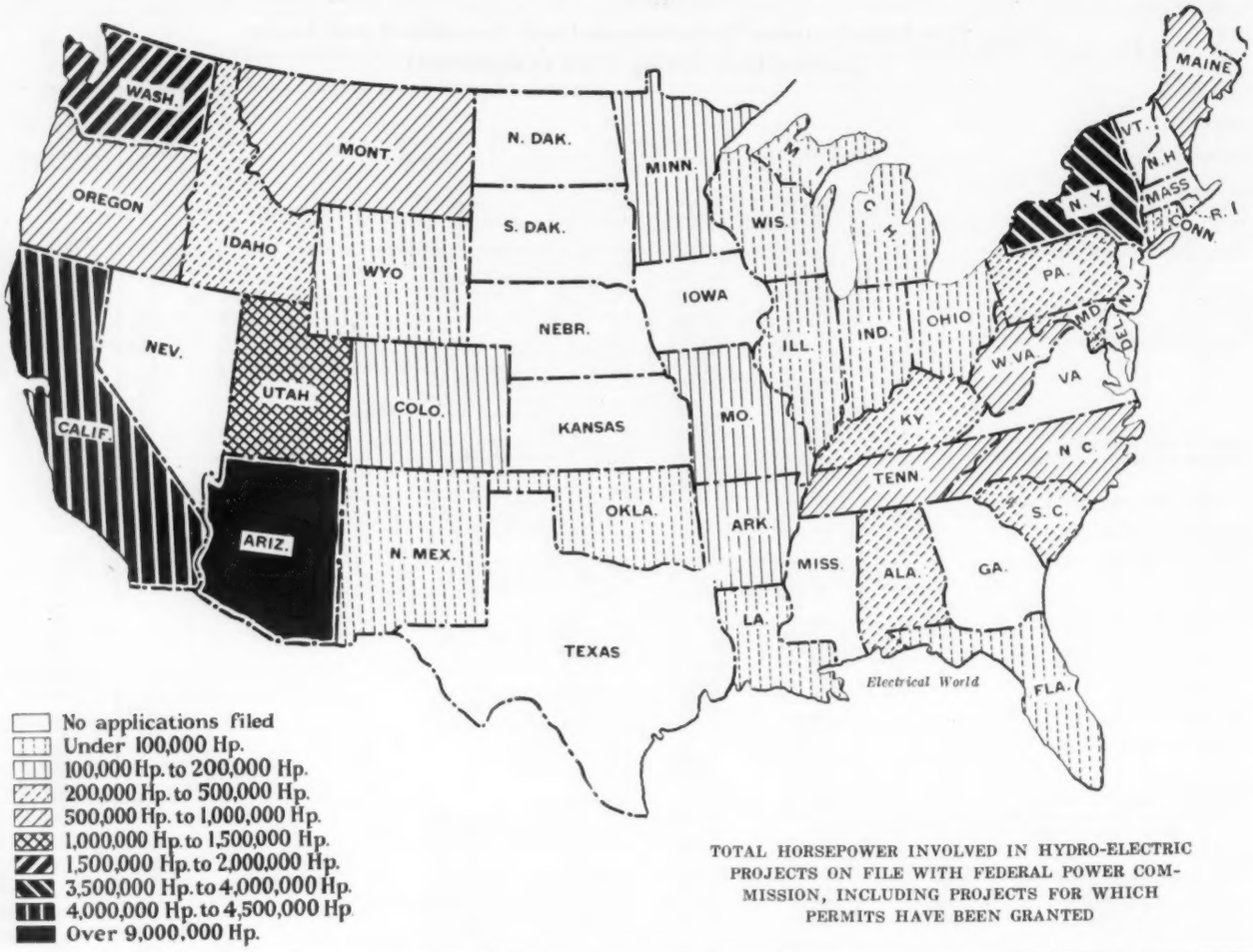
Name of Company	Estimated Cost of Line	Voltage	Terminals	Length (Single Circuit, Miles)	Completion of Construction
Alabama:					
Alabama Power Co.	*$412,000	110,000	Lock 18, Cherokee, North Auburn, Lanett	58	1924
	*100,000	44,000	Upper Tallassee, Union Springs	35	1924
	*81,000	44,000	Upper Tallassee, Montgomery	28	1924
	*39,000	40,000	Notasulga, Upper Tallassee	14	1924
	*68,500	44,000	Carbon Hill, Brilliant, Guin	24	1924
	*47,500	44,000	Magella, Leeds	16	1924
	*45,500	44,000	Leeds, Fulton Springs	16	1924
	*36,000	44,000	West Blockton, Rock Castle	12	1924
	*19,700	44,000	Big Sandy Tap	7	1924
	*25,000	44,000	Keystone, Calera	9	1924
	*13,000	44,000	Black Creek Coal Co. Tap	5	1924
	*17,700	44,000	Mount Meig Tap	6	1924
	*24,600	44,000	Lock 12, Calera	8	1924
	*110,000	44,000	Habgood, Decatur	38	1924
	*90,000	44,000	Montgomery, Georgiana	31	1924
California:					
California-Oregon Power Co.	700,000	110,000	Copco No. 2 Plant, Delta	77	1924
	71,343	34,000	Etna, Victory Mine	16	1924
	58,679	60,000	Lucerne, Weed	15	1924
Pacific Gas & Electric Co.	1,624,000	110,000	Vaca Dixon sub., Newark sub		1924
	914,100	110,000	Cooley Landing, Martin sub		1925
	412,500	220,000	Pit No. 3 Plant, Pit, Vaca Dixon line	29	1925
	33,200	110,000	Redwood sub., West Point Cement Plant	2	1924
		60,000	Three short taps	4	1924
San Diego Consol. Gas & Electric Co.	*89,000	88,000	Escondido, Rincon	16	1924
San Joaquin Light & Power Corp.	68,457	60,000	Modesto, Livingston	51	1924
	127,256	60,000	Le Grande, Exchequer plant of Merced Irrig. Dist.	30	1925
Southern California Edison Co.	100,000	60,000	Kaweah, Venida	20	1924
	100,000	60,000	Tule, Strathmore	20	1924
	70,000	60,000	Lancaster, Redwood	14	1924
	101,000	60,000	Culver City, Redondo, Inglewood	22	1924
	353,000	60,000	Miscellaneous short lines	67	1924
Connecticut:					
Connecticut Light & Power Co.	*30,400	66,000	Southington, Meriden	5	1924
	*265,000	66,000	Devon, Norwalk	47	1924
Connecticut Power Co.	*5,630	66,000	Berlin Pt. 12, Cromwell	1	1924
	*5,630	66,000	Berlin Pt. 12, Hartford	1	1924
Florida:					
Pinellas County Power Co.	.....	60,000	St. Petersburg, Tarpon Springs, West Coast	.....	.....
Georgia:					
Georgia Railway & Power Co.	.....	110,000	Tallulah Falls, Toccoa, Commerce, Winder, Norcross, Morgan Falls, Marietta		1924
	*464,000	110,000	Lindale, Summerville, Lafayette, Chickamauga, Chattanooga	65	1924
	*58,000	38,000	Commerce, Royston	20	1924
	*69,500	38,000	Marietta, Ball Grounds, Tate	24	1924
Georgia-Alabama Power Co.	*250,000	44,000	Albany, Valdosta	86	1924
Columbus Electric & Power Co.	500,000	.....	Bartlett's Ferry, Manchester	35	1925
Idaho:					
U. S. Reclamation Service	*130,000	33,000	American Falls, Burley	45	1924
Illinois:					
Commonwealth Edison Co.		132,000	Calumet station south to Chicago city limits		1924
	1,000,000	132,000	Calumet Station, East Gary, Ind.	16	.....
	.....	132,000	Joliet station of Pub. Serv. Co. East to lines of No. Ind. Gas & Elec. Co.		
	*193,000	132,000	Waukegan, Evanston	27	1924
Illinois Power & Light Co.	3,000,000 to 5,000,000		Peoria, Bloomington, Springfield, Decatur, Champaign, Danville, also Peoria, Keokuk		1927
Illinois Northern Utilities Co.	39,966	33,000	Freeport, Lena	13	1924
Indiana:					
Interstate Public Service Co.	265,000	66,000	Scottsburg, Bedford	43	1924
	93,500	66,000	Ohio State Line, Connersville	20	1924
	88,600	33,000	Logansport, Brownell	25	1924
	40,000	33,000	Goshen, Michigan State Line	14	1924
	50,700	33,000	Seymour, North Vernon	17	1924
American Gas & Electric Co.	168,400	132,000	South Bend, Twin Branch	.....	1925
Iowa:					
Continental Gas & Electric Corp.	40,350	33,000	Clarinda, Missouri State Line	11	1924
	47,000	33,000	Clarinda, Villisca	15	1925
	25,000	33,000	Lewis, Marne	11	1925
Kansas:					
Kansas Gas & Electric Co.	*84,500	66,000	Pittsburg, Mulberry	15	1924
	*96,000	66,000	Cherryvale, Coffeyville	17	1924
	*152,000	66,000	Coffeyville, Fredonia	27	1924
Kansas Power & Light Co.	.....	.....	Tecumseh, Atchison		1924
Kentucky:					
Kentucky Utilities Co.	535,000	132,000	Pineville, Dix Dam	93	1924
	158,000	66,000	Morganfield, Ill. State Line	9	1924
	56,000	66,000	Black Star, Cay Wood	11	1924
	*790,000	66,000	Shelbyville, Pineville	140	1924
	880,000	33,000	Twenty-four miscellaneous lines	276	1924
Kentucky Hydro-Electric Co.	898,000	66,000	Dix Dam, Lexington	22	1924
			Dix Dam, Finchville, Louisville	70	
			Finchville, Shelbyville	7	
Old Dominion Power Co.	52,900	66,000	Big Stone Gap, Dorchester	10	1924
Maine:					
Central Maine Power Co.	30,000	33,000	Guilford sub., Milo	.....	1924
	10,000	33,000	Rice Rips sta., Fort Halifax station	.....	1924
	12,000	33,000	Weston station, Lakewood Jct.	.....	1924
	45,000	33,000	Union sub., Glen Cove sub.	.....	1924
	45,000	33,000	Wiscasset sub., Damariscotta Mills station	.....	1924
Maine & New Brunswick Power Co.	.....	.....	Bridgewater, Me., Woodstock, N. B.	.....	1924
Cumberland County Power & Light Co.	.....	66,000	Saco Valley, Saco	.....	1924
Massachusetts:					
New England Power Co.	*7,140	110,000	Davis, Bridge Milbury	1	1924
Michigan:					
Indiana & Michigan Electric Co.	*17,400	33,000	Norway Point, Alpena	6	1924
Minnesota:					
Minnesota Power & Light Co.	*464,000	110,000	Thomson, Nashwauk	65	1924
	*928,000	110,000	Blanchard, Nashwauk	130	1924
	*72,500	44,000	Ely, Tower	25	1924
Northern States Power Co.	300,000	110,000	Encircle Minneapolis and St. Paul	60	1924
Missouri:					
Continental Gas & Electric Corp.	*84,000	33,000	Maryville Mo., Iowa State Line	29	1924
Nebraska:					
Continental Gas & Electric Corp.	41,958	33,000	Norfolk, Pierce	24	1924
	335,000	66,000	Lincoln, Plattsmouth	64	1924

Table IV—High-Tension Transmission Lines Completed and Under Construction During 1924 (Concluded)

Name of Company	Estimated Cost of Line	Voltage	Terminals	Length (Single Circuit, Miles)	Completion of Construction
New Jersey:					
Atlantic City Electric Co	165,000	66,000	Hammonton, Woodstown	26	1924
American Gas & Electric Co	48,300	66,000	Atlantic City, Williamstown	7	1925
New York					
Adirondack Power & Light Co	126,000	110,000	Beardslee Falls south to Herkimer Co. Line	11	1924
	†443,600	110,000	North Albany, N. Y., Adams, Mass.	..	1924
	66,400	66,000	Inghams, Beardslee Falls	....	1924
	268,300	110,000	Glen Falls, Thomsons	....	1924
	135,200	66,000 / 33,000	Spier Falls, Glen Falls	10	1924
Associated Gas & Electric Cos	*58,000	44,000	Delhi, Walton	20	1924
	*58,000	44,000	Delhi, Stamford	20	1924
	*101,000	44,000	Delhi, Andes, Margaretville, Fleishmanns, Shandakin	35	1924
	*29,000	44,000	Liberty, Livingston Manor	10	1924
	*40,600	40,000	Latham Corners, New Berlin	14	1924
	*200,000	110,000	Herkimer Co. Line south to Colliers	28	1924
	*128,500	110,000	Colliers, Delhi	18	1924
Niagara Falls Power Co	*160,000	60,000	Echota, Gardenville	28	1924
Niagara, Lockport & Ontario Power Co	430,000	110,000	Orwell, North Syracuse	65	1924
	153,000	110,000	North Syracuse, Sullivan	34	1925
	57,000	60,000	Mortimer sub., Rush	7	1925
Northern New York Utilities, Inc	408,000	.....	Boonville, Rome	24	1925
	595,000	.....	Black River, Altmar	35	1925
Staten Island Edison Corp	120,000	33,000	Livingston, Eltingeville	....	1924
North Carolina					
Carolina Power & Light Co	*200,000	100,000	Fayetteville, Duke	28	1924
	*141,000	66,000	Biscoe, Ashboro	25	1924
	*62,000	66,000	Ashboro, Deep River	11	1924
Ohio					
Ohio Gas & Electric Co	480,000	132,000	Lima, Fostoria	....	1924
	1,320,000	132,000	Lima, Twin Branch, Ind	....	1925
	1,120,400	132,000	Philo, Canton	....	1924
	205,400	132,000	Philo, Crooksville	....	1924
	118,800	66,000	Fostoria, Pemberville	....	1924
	917,000	132,000	Pomeroy, South Point	....	1926
Ohio Public Service Co	1,500,000	132,000 / 66,000	Ashland-Lorain / Mansfield-Ashland	44 / 14	1924
Penna.-Ohio Power & Light Co	237,000	132,000	Warren-Youngstown	10	1924
	37,000	66,000	Lowellville-Bessemer	6	1925
	40,000	66,000	Leetonia-Lisbon	7	1925
Oklahoma					
Oklahoma Gas & Electric Co	*417,000	63,000	Harrah-Byng	74	1924
Public Service Company of Oklahoma	*61,900	66,000	Limestone Gap-Stringtown	11	1925
Southwestern Light & Power Co	.....	.....	Lawton Okla.-Quanah, Tex	....	1924
Southwest Power Co	*169,000	66,000	McAlester-Atoka Co. Line	30	1924
Oregon					
California Oregon Power Co	106,160	60,000	Ashland-Gold Ray	23	1924
	*31,000	60,000	Line 12 Roseburg	6	1923-24
Pacific Power & Light Co	250,000	66,000	Pasco, Wash.-Umatilla-Pendleton, Ore	61	1924
Portland Electric Power Co	*15,800	57,100	Station G, Station M	3	1924
Pennsylvania					
Pennsylvania Power & Light Co	*96,000	66,000	Hauto, Shenandoah	17	1924
	*848,000	220,000	Hawley, Wallenpaupack	60	1925
Penn Public Service Co	*385,000	110,000	Piney, Union City	54	1924
	*692,000	110,000	Glory, Piney	97	1923-24
Pennsylvania Water & Power Co	*84,500	70,000	Holtwood, Lancaster	15	1924
Scranton Electric Co	84,800	66,000	Scranton, Peckville	8	1924
West Penn Power Co	*900,000	66,000	Springdale, Charleroi, Cheat Haven, Morgantown, Rivesville	160	1924
Tennessee:					
Tennessee Electric Power Co	*85,000	66,000	Mascot, Jefferson City	15	1924
	*160,000	120,000	Knoxville, Coal Creek	22	1924
	*25,700	110,000	Chattanooga, Rossville, Ga	4	1924
	*29,000	44,000	Power Loop around Chattanooga	10	1924
	*585,000	120,000	Cleveland, Knoxville	82	1924
	*107,000	66,000	Coal Creek, Buffalo	19	1924
	*18,700	66,000	Miscellaneous	3	1924
Texas:					
Houston Lighting & Power Co	29,000	33,000	Deepwater, Houston	10	1924
Texas Power & Light Co	*735,000	132,000	Leon, Hillsboro	103	1924
	*631,000	66,000	Hillsboro-Tyler	112	1924
	*197,000	66,000	Athens, Palestine	35	1924
	*96,000	66,000	Royse City, Terrell	17	1924
	*428,000	66,000	Norwood, Sunset	76	1924
West Texas Electric Co	*116,000	33,000	Sweetwater, Colorado	40	1924
Wichita Falls Electric Co	*310,000	66,000	Wichita Falls, Sunset	55	1924
	*188,500	33,000	Wichita Falls, Knox Co	65	1924
Virginia:					
Virginia-Western Power Co	*257,000	110,000	Charlottesville, Staunton	36	1923-24
	*307,000	110,000	Clifton Forge, Va., Roncevert, W. Va	43	1926
Washington:					
Washington Water Power Co	*214,000	110,000	Long Lake, Spokane	30	1924
	*271,000	110,000	Spokane, Tekoa	38	1924
	*621,000	110,000	Long Lake, Stratford	87	1925
	*171,000	110,000	Neppel, Taunton	24	1924
Puget Sound Power & Light Co	*178,000	110,000	Baker River plant, Sedro-Woolley	25	1925
	*141,000	60,000	Sedro-Woolley, Bellingham	25	1924
	*321,000	110,000	Sedro-Woolley, Everett	45	1924
	285,000	55,000	Electron Plant, Tenino	38	1924
	.....	.....	Olympia, Tenino	10	....
West Virginia:					
American Gas & Electric Co	1,222,500	132,000	Logan, St. Albans	43	1925
		132,000	Rutland, O., Kenova, W. Va	65	1925
	1,917,600	132,000	Philo, O., St. Albans, W. Va	115	1925
Virginian Power Co	150,000	44,000	Extensions	....	1924
Wisconsin:					
Wisconsin Public Service Corp	350,000	66,000	Green Bay, Oshkosh	58	1925
Milwaukee Electric Railway & Light Co	*364,000	132,000	Milwaukee, White Water	51	1924
	*157,000	132,000	Milwaukee, Racine	22	1924
Milwaukee Elec. Railway & Light Co / Wisc. Traction, Light, Heat & Power Co	269,768	.....	Hilbert, Plymouth	60	....
Wisconsin Power, Light & Heat Co	64,875	33,000	Markesan, Dalton, Manchester	..	1924
Wisconsin Power & Light Co	75,500	66,000	Janesville, Orfordville, Monroe	39	1924
Northern States Power Co	552,000	120,000	Wissota, Eau Claire	13	1924
			Wissota, South St. Paul	77	1924

* Estimated by ELECTRICAL WORLD, based on cost of lines for which cost data were reported.

† One-half of North Albany line owned by New England Power Company. Cost given is for Adirondack Power & Light Company only.



TOTAL HORSEPOWER INVOLVED IN HYDRO-ELECTRIC PROJECTS ON FILE WITH FEDERAL POWER COMMISSION, INCLUDING PROJECTS FOR WHICH PERMITS HAVE BEEN GRANTED

Table V—List of Power Projects Completed in 1924 or Under Construction Under License from the Federal Power Commission as of Nov. 1, 1924

Project No.	Name	Stream	State	Proposed Ultimate Installation, Hp.	Estimated Cost	Scheduled Date of Completion	Hp. Scheduled, Already in Operation or to Be Placed in Operation 1924	1925	1926	Remarks re Estimated Cost
16	Niagara Falls Power Co.	Niagara	N. Y.	601,835	$5,494,000	9-1-24	210,000	.....	.....	For 210,000 hp. only, including substation and transmission line to this substation
20	Utah Power & Light Co.	Bear	Idaho	21,000	2,500,000	7-1-26	.....	.....	21,000	.....
52	City of Dothan	Choctawhatchee	Ala.	4,500	658,000	9-1-26	.....	.....	4,500	.....
67	Southern California Edison Co.	San Joaquin	Cal.	545,000	61,152,000	7-1-35	.....	.....	.....	.....
77	Snow Mountain Water & P. Co.	South Fel.	Cal.	14,730	6,665,000	7-1-26	.....	.....	4,000	Including about 110 miles of transmission line
88	Merced Irrigation District	Merced	Cal.	33,000	13,478,000	7-1-27	.....	.....	.....	Complete project
120	Southern California Edison Co.	San Joaquin	Cal.	195,000	13,890,000	12-31-29	.....	.....	.....	.....
135	Portland Electric Power Co.	Clackamas	Oregon	35,000	2,685,000	12-31-25	35,000	.....	.....	.....
175	San Joaquin Lt. & Power Corp.	San Joaquin	Cal.	266,000	50,970,000	1-1-31	41,000	.....	41,000	.....
176	Escondido Mutual Water Co.	San Luis Rey	Cal.	1,000	260,000	9-1-26	.....	.....	*360	.....
177	Oklawaha Reclamation Farms.	Oklawaha	Fla.	700	112,000	7-1-26	.....	.....	700	Including 30 miles of transmission line
184	El Dorado Power Co.	South Fork American	Cal.	100,000	8,922,319	12-31-28	.....	20,000	.....	.....
185	Southern California Edison Co.	Lost Creek et al	Cal.	4,000	630,000	12-31-25	.....	.....	4,000	.....
187	Yuba River Power Co.	North Fork Yuba	Cal.	7,000	894,200	12-31-24	7,000	.....	.....	.....
233	Mount Shasta Power Corp.	Pit River	Cal.	99,000	13,041,600	12-31-26	.....	.....	99,000	Including 8½ miles of transmission line
271	Arkansas Light & Power Co.	Ouachita	Ark.	96,000	8,055,000	7-1-36	.....	40,000	.....	.....
276	Houston Power Co.	Choctawhatchee	Ala.	4,800	508,871	10-1-25	.....	†3,600	.....	Including 3,600 hp. elec. machinery
280	Wilson, F. M.	Wilder Creek	Cal.	15	3,000	1-1-25	.....	15	.....	Assumed cost, $200 per hp.
287	State of Illinois, et al.	Fox	Ill.	5,500	800,000	7-1-26	.....	.....	5,500	.....
309	Clarion River Power Co.	Clarion	Pa.	42,500	6,460,000	12-1-27	11,000	.....	.....	.....
312	Molybdenum Corp. of America	Red	N. M.	530	67,000	7-1-26	100	.....	430	.....
344	San Gorgonio Power Co.	San Gorgonio	Cal.	2,250	300,000	3-31-25	2,250	.....	.....	Including 10 miles of transmission line
346	Pike Rapids Power Co.	Mississippi	Minn.	24,000	2,380,000	7-1-26	.....	.....	24,000	.....
349	Alabama Power Co.	Tallapoosa	Ala.	180,000	10,000,000	9-1-40	.....	.....	.....	Including cost of 67,000 hp. of apparatus only
362	Ford Motor Co.	Mississippi	Minn.	19,200	1,475,000	7-1-25	19,200	.....	.....	Exclusive of United States dam
375	Humphreys, A. E.	Roaring Fork Creek	Col.	10	2,000	1-1-24	10	.....	.....	Estimated cost, based on $200 per hp.
386	Unity Gold Mines Co.	Elk Creek	Idaho	480	72,000	1-1-25	480	.....	.....	No detailed estimate available; $150 per hp. assumed
395	Johnson, C. B.	Sawmill Creek	Cal.	325	35,000	7-1-26	.....	.....	325	.....
396	City of Sacramento	American	Cal.	15	2,770	9-1-24	15	.....	.....	.....
401	Michigan Gas & Electric Co.	St. Joseph	Mich.	2,300	454,830	1-1-26	2,300	.....	.....	.....
404	Carvey, L. H.	Lagoon Creek	Alaska	160	32,000	6-1-25	.....	160	.....	Based on estimate of $200 per hp.
436	Winino Mineral Springs	Salt Creek	Ore.	70	7,000	1-1-25	70	.....	.....	.....
437	Mount Reuben Mining Co.	Reuben Creek	Ore.	16	3,200	10-1-25	.....	16	.....	Based on estimate of $200 per hp.
443	Damgaard, Andrew	Glen Creek	Cal.	4	400	7-1-24	4	.....	.....	Based on estimate of $200 per hp.
451	Humphreys, A. E.	Goose Creek	Col.	650	157,900	11-1-25	.....	325	.....	Estimate includes one 325-hp. unit only
487	Pennsylvania Power & Lt. Co.	Wallenpaupack	Pa.	54,000	7,730,000	8-1-28	.....	.....	.....	.....
	Totals			2,360,590	$219,898,090		328,429	64,116	204,815	

* Partly constructed: horsepower to complete. † Remainder on market demand.

TABLE VI—DATA ON APPLICATIONS ON FILE WITH THE FEDERAL POWER COMMISSION, NOVEMBER 1, 1924

	Number	Horsepower: Primary Power (90 per Cent of Time)	Horsepower: Estimated Ultimate Installation
Preliminary permits issued	120	.....	.....
Canceled, expired or superseded by license	40	.....	.....
Permits outstanding	80	2,616,125	5,528,200
Licenses issued	151	.....	.....
Revoked or surrendered	5	.....	.....
Licenses outstanding	146	1,209,380	2,931,240
Total capacity:			
Live cases, November 1, 1923		17,718,915	28,040,166
Filed during year		920,976	2,366,062
Total November 1, 1924		18,639,891	30,406,228
Rejected, expired, canceled or withdrawn during year		827,075	1,368,960
Net active		17,812,816	29,037,368
Conflicts		4,869,480	6,842,300
Net project capacity		12,943,336	22,195,068
Total filed to November 1, 1924			550

totaling 2,366,062 hp. ultimate installation were filed. The net ultimate capacity of the active projects on file with the commission on November 1, 1924, was 22,195,068 hp.

As the Federal Power Commission says in its fourth annual report: "We have no national surplus of water-power resources. Our best estimates indicate that we have a total of fifty-five billion horsepower of developed and undeveloped water power available for 50 per cent of the time. The combined installation in central electric stations, electric railways and industries in the United States in 1924 is estimated at fifty-six million horsepower, with several millions more employed in railroad transportation. Our present power demands, therefore, exceed our total water-power resources and we should not permit waste in their development. Furthermore, 72 per cent of our water-power resources are west of the Mississippi, while 79 per cent of our power requirements are east of that river. In the eleven northeastern States, where our greatest industrial concentration is to be found, our total water-power resources are less than one-third of the present power demands, exclusive of the railroads."

One of the outstanding contemplated hydro-electric developments of the near future in the East is the Conowingo development of the Susquehanna Power Company with an ultimate rating of 700,000 hp. Renewed agitation for the development of the St. Lawrence River to relieve the continually growing power load of the Eastern States is much in evidence.

HYDRO AND STEAM DEVELOPMENT IN THE WEST

Following a very active construction year by all of the power companies of the Pacific Coast, 1924 witnessed an increase over 1923 of more than 100 per cent in generating equipment placed in service. A total of 356,000 kva., consisting of 234,000 kva. hydro and 122,000 kva. steam-plant capacity, was placed in service during 1924, as compared with a total of 150,000 kva. for the year previous. For 1925 it is predicted that the installation of 342,000 kva. in hydro-electric capacity and 73,000 kva. in steam will be completed.

One of the largest and most important hydro-electric developments now under way in the West is the Pit River No. 3 plant of the Pacific Gas & Electric Company, which will add 75,000 kva. to the system of that company in July of this year. Besides this there is the Moccasin Creek power plant of the city of San Francisco, which will bring in 80,000 kva. during the early spring.

Hydro-electric development in Canada was also very active during 1924. The initial installation of 360,000 hp. of the Quebec Development Company, Ltd., at Isle Maligne, on the Saguenay River, which will be completed during 1925, is one of the outstanding hydro-electric developments of the continent. This is being undertaken by the Duke-Price interests.

MANY TRANSMISSION-LINE EXTENSIONS

During 1924 large extensions were made to the transmission systems of the country, involving millions of dollars. The undertakings included in the accompanying table are only the largest of the extensions and additions which have been under construction during the past year. The first 220,000-volt line east of the Rockies has been announced by the Pennsylvania Power & Light Company for transmission from Hawley, Pa., the site of the Wallenpaupack hydro-electric station, to the Siegfried receiving substation, a distance of 60 miles. This line will probably be the initial unit in an extensive system.

No new 220-kv. lines were placed in operation in the West during the past year with the exception of a 9-mile extension to the Pit River line of the Pacific Gas & Electric Company to connect with the new Pit No. 3 plant. During 1925, however, the Southern California Edison Company will begin construction on a third 220-kv. line from its Big Creek development to Los Angeles. This line will be approximately 250 miles in length and will augment the two existing 270-mile lines in bringing in the next large block of power from the Big Creek project. With the merger of the San Joaquin Light & Power Corporation and the Great Western Power Company during December came the announcement that construction would begin immediately on a 100-mile, 220-kv. transmission line between Sacramento and Merced, Cal., to provide a large-capacity direct interconnection between the systems of the two companies. This will make three 220-kv. lines under construction in the country during the year 1925.

TABLE VII—LIST OF TRANSMISSION LINES UNDER CONSTRUCTION UNDER LICENSES ISSUED BY THE FEDERAL POWER COMMISSION AS OF NOVEMBER 1, 1924*

Project No.	Name of Applicant	Estimated Cost per Mile	Scheduled Date of Completion	Miles Included in License	Voltage of Line
474	Southern California Edison Co.	$1,820	1-1-25	12	33,000
482	Gila Valley Power Co.	1,913	4-1-25	15	33,000
490	San Diego Consolidated Gas & Electric Co.	6,300	1-1-25	2	88,000
523	Southern California Edison Co.	No detail	7-1-26	6	11,000

* A total of twenty-three licenses for transmission lines (constructed or to be contructed) for the period of November 1, 1923, to November 1, 1924, have been issued.

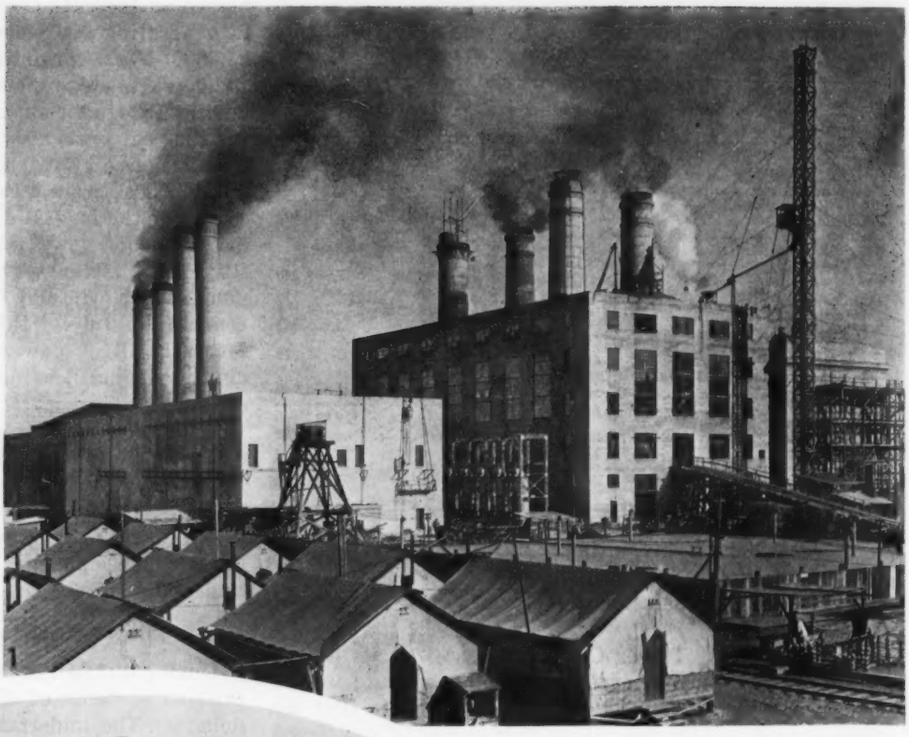
TABLE VIII—ESTIMATED OIL AND DIESEL ENGINE-DRIVEN GENERATOR SETS INSTALLED DURING 1923 AND 1924

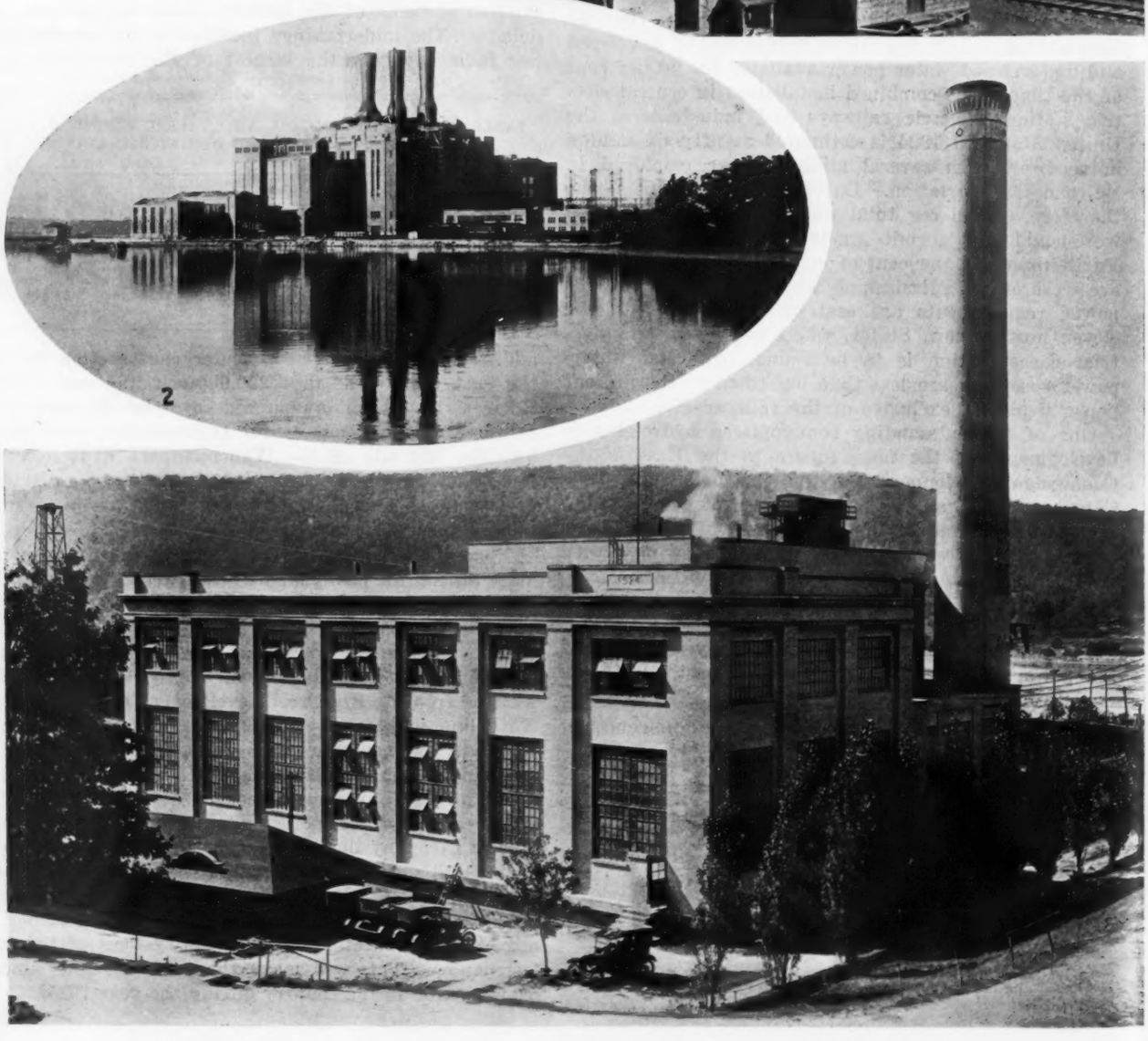
	1924	1923
Number of units installed	145	135
Aggregate horsepower of all units	43,700	42,000
Aggregate horsepower of units installed in central-station plants	32,870	25,100
Aggregate horsepower of units installed in private electric generating plants	10,830	16,900
Approximate total value of plants complete	$4,780,000	$4,810,000

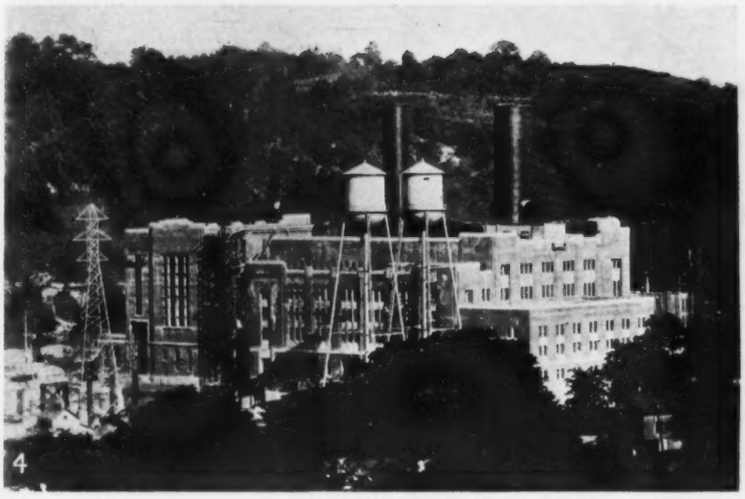
Steam Station Developments

THE year 1924 was epoch-making in power-station development in that several stations were started and some completed which embodied radically new ideas in design. Steam pressures of 550 lb. were adopted for stations in Philadelphia, Chicago and elsewhere, and the Weymouth plant inaugurated the use of the 1,200-lb. boiler. Reheating, bleeding and air preheating became a matter of practice in many plants, and as usual the year witnessed more records in size of turbines, boilers and generators.

One of the radical innovations is the use of vertical condensers set at the same elevation as the turbine in the Crawford Avenue station, and the new Miami Fort station will be interesting in that it will use very deep condenser wells and an installation of an unusual character for burning pulverized fuel. The mercury turbine at Hartford continues to operate,







and new developments in this unusual type of unit are awaited with interest. Henry Ford at Walkerville, Ontario, has completed a low-distillation, powdered-fuel, byproduct plant whose operating success and over-all economy will determine the possibilities in fuel conservation of this type of installation.

The use of large stations is still popular and the new stations are more efficient than ever and the art of production has advanced rapidly.

TYPICAL STATIONS

No. 1. Long Beach station of Southern California Edison Company was built to relieve power conditions during the water shortage.

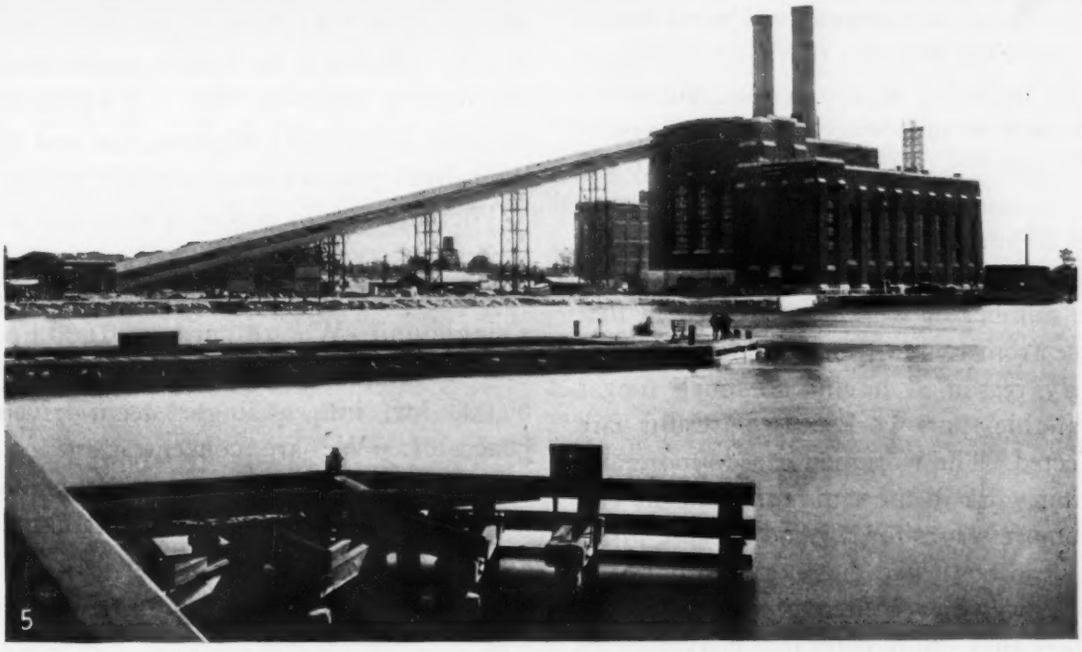
No. 2. Trenton Channel station of the Detroit Edison Company has many unusual features.

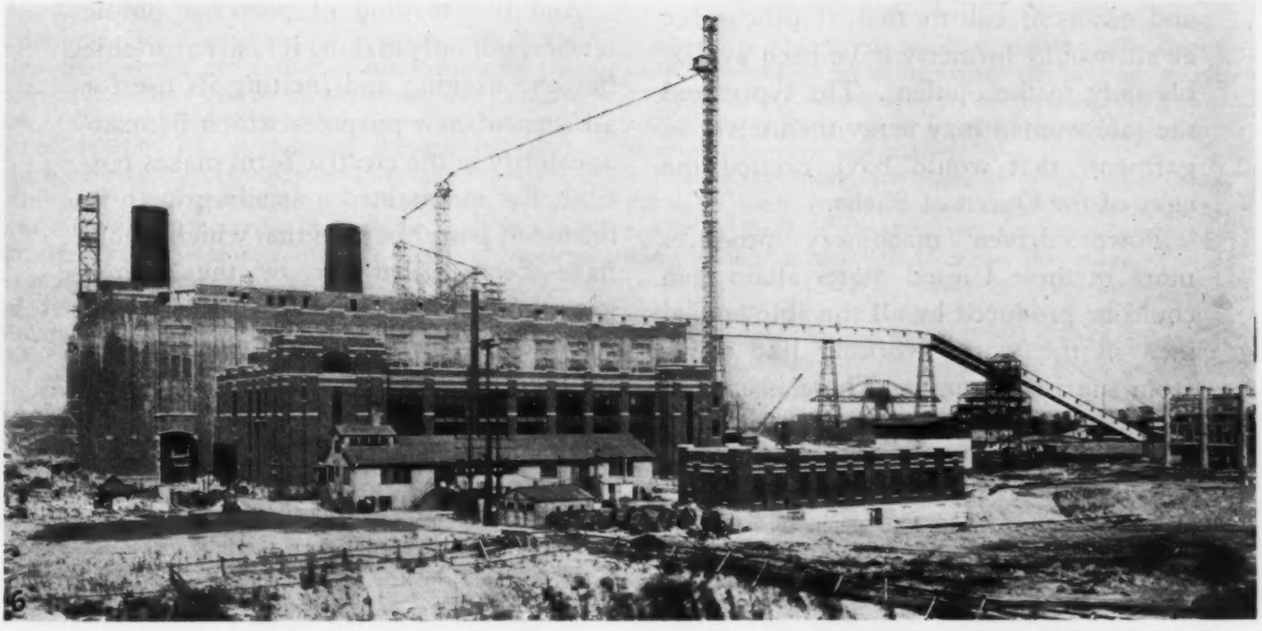
No. 3. Hale's Bar station of the Tennessee Electric Power Company is typical of those operating in conjunction with large hydro-electric systems.

No. 4. Philo station of the American Gas & Electric Company represents a high pressure, high economy, mouth-of-mine plant.

No. 5. Weymouth station of the Edison Electric Illuminating Company of Boston will use a 1,000-lb. turbine.

No. 6. Crawford Avenue station of the Commonwealth Edison Company in Chicago has many new features in station design, including reheating, steam extraction and unusual condenser arrangements.





Making Power a Public Service

By Fred R. Low

Past-President American Society of Mechanical Engineers and Editor of "Power"

NO OTHER country in the world has so much power available for its workers as the United States. In 1869, the first year that power statistics were included in the census, there was available to each wage earner in the mills and factories of the United States 0.6 hp. In the last census, that of 1919, the figure is 3.27 hp. per worker. Six times as much horsepower per worker in fifty years, and the number of workers increased in that time from two million to nine million.

By reason of having so much power available per worker two results are effected. The workman can do more and better work in the same time, and he can get more wages for it. And because products can be turned out in great quantities by power-driven machinery the wage earner may enjoy comforts, conveniences and means of culture that, if procurable at all, would formerly have been available only to the opulent. The typist and the saleswoman may array themselves in garments that would have excited the envy of the Queen of Sheba.

Power-driven machinery produces more in these United States alone than could be produced by all the able-bodied men in the world working like slaves from sunrise to sunset. There is enough power-generating machinery installed in this country to do for each man, woman and child in the land the work of 150 slaves if it were running at full capacity all the time. Moreover, the effort for greater efficiency in power production has been so intensive that it is virtually the only commodity affecting the cost of living still procurable at pre-war prices.

The tendency in power is toward concentration, centralization. We are concentrating a whole battery of boilers into a single unit. We are putting 70,000 hp. into a single hydraulic turbine and 60,000 kw. into a single steam-driven generator. We are concentrating into great power houses, the capacity of which is measured in hundreds of thousands of kilowatts, the generating power formerly distributed in great numbers of small, inefficient installations.

And this making of power a public service, not only making it easily available but encouraging and inciting its use for all sorts of new purposes which its manageability in the electric form makes possible, has maintained a steady growth in the use of power beyond that which would have been called for by the normal growth of industry alone. At their present rate of growth the great electric companies of this country would double their output in less than seven years. Here is a thought worth pondering.

The Economics of Interconnection

Present Tendencies—Some Questions for Every Utility Man to Ask Himself in Order to Ascertain Whether Interconnection Is Not Better than Isolated Existence

By M. L. SINDEBAND
Electrical Engineer American Gas & Electric Company

WITH a few exceptions, present tendencies seem to point very definitely toward the supplying of the base load of the system or group of systems by either a single plant or a group of highly efficient plants, these being situated not particularly with regard to the location of the load, but more chiefly with regard to the availability of the proper supply of coal and condensing water. The tendency is also apparently to interconnect these plants by means of high-tension transmission lines serving substations from which radiate secondary transmission lines and distribution lines serving the various communities. As a result, individual communities, instead of being dependent upon a single source of supply, will generally be able to call upon two or three sources, so that the occurrence of a disturbance or of an interruption at any one source should not interrupt the service to a particular community. Furthermore, the tendency is to shut down the smaller and inefficient stations and keep them either for emergency generation or for helping to carry abnormally large peaks.

An exception to the tendency outlined exists in very large cities because of load concentration, the impossibility of bringing in high-voltage overhead wires and the absence of any high-voltage underground cable that can be depended upon at present. As a result, a large percentage of the load of these large cities will be served by local generating stations with perhaps limited ties to outside generating sources. If high-voltage underground cable should be sufficiently developed, generating stations would not have to be built within the confines of city boundaries unless economic conditions warranted such a location.

However, the average city of moderate size will not necessarily have a generating station within its boundaries, but will be fed by an interconnected transmission system supplied by a group of stations. Continuity of service will be assured through the proper functioning of the transmission lines aided by proper maintenance and automatic sectionalization. Great strides have been made in the past in providing auxiliary facilities to assure continuity of service, such as the marked advance in relays and relay application and the development of remote-control supervisory equipment for switching stations and substations.

Limitations on Interconnections

A consideration of interconnection brings up several questions, such as: How great will the size of the stations grow? What distances will single transmission lines be carried? To what value will voltages be raised? Development of the past ten years has shown that unless radical changes occur in both the steam and electrical ends of power plants as known at present, the size of individual steam stations will in the future be limited to somewhere between 200,000 kw. and 300,000 kw. The size will generally be limited on the steam end by the amount of condensing water available at any particular stream or river (except in unusual cases) and on the electrical end by the amount of power that it is advisable to concentrate at any point before the disadvantages of concentration, such as high magnetic stresses and large rupturing duties in oil circuit breakers, become so heavy as more than to counterbalance the economies possible by increasing the size of the stations. Obviously, then, the need for transmitting any very large blocks of power any great distance is remote, since the limited size of generating stations makes it desirable to scatter them, locating them with respect to the availability of condensing water and coal and within striking distance of load centers.

To transmit the output of a single station of, say, 300,000 kw. within a radius of 100 miles will not require the handling of large blocks of power on any one line for an appreciable distance and will therefore not call for very high voltages. The limit for a good many years will probably be 230,000 volts, and it may be found that the economic justification for even that high voltage will appear in only a few cases. The trunk lines will serve more as leveling connections between the various generating stations and as main feeders to secondary transmission and distribution points to be located where load requirements call for them.

Development has reached the point where several companies have joined and are joining in a particular development for the combined use of generating as well as transmission facilities.

Studies Essential to Interconnection

Assuming that there are two systems belonging to the same group of operating organizations or to separate groups which it is desirous to interconnect, the following points would have to be studied and analyzed to reach an economic conclusion:

1. *Load of Individual Systems.*—This study being made for each system, a load curve representing the combined loads of the two systems properly synchronized should be established. From this curve it would be possible to obtain a number of facts, among them being:

(a) The gain in load factor of the combined systems.

(b) The amount of extra load that could be carried by the same generating capacity.

(c) A reference curve on which to base the operating arrangements so as to utilize the most economical equipment at all times.

2. *Generator and Boiler Capacity of the Two Systems.*

3. *Reserve Capacity of Combined Systems.*—From 1 and 2 the reserve capacity of each system is obtainable and, having the combined load curve of the two systems, the reserve capacity for the combined systems can be calculated. The difference between this new reserve

capacity and the sum of the previous individual reserve capacities is the amount of capacity which is gained as a result of interconnection and which is made available and can be sold to consumers.

4. *Exchange Power and Effect on Interconnection.*—From an analysis of the combined load curve of the two systems and the generating capacities available at the various points a decision as to amount of power that it may be desirable to transfer under normal conditions and under emergency conditions can be obtained. Coupled with a knowledge of the existing transmission systems, enough data are available to decide the voltage of the interconnecting lines and the amount of transformer capacity necessary.

5. *Design of Transmission Lines.*—In laying out the transmission line a number of points have to be studied to insure a satisfactory operation, some of which follow:

(a) The size of conductor employed. The economic size of conductor is not different in this problem from what it is in any other transmission problem.

(b) The voltage of the transmission line. This will be governed largely by local existing transmission systems, the voltage at interconnection points and the voltage at terminal points feeding the points of interconnection. If the systems are large and each has its own generating capacity, it is quite obvious that neither can change its voltage at the generating station when changing from a sending to a receiving condition. Transfer of energy has to be carried out at constant potential. To make this possible the transformer specifications and ratios have to be watched to insure that the necessary taps will be available and further that the changing of taps to meet sending and receiving conditions can be made as simply and quickly as possible. None of the existing schemes of changing ratios, with the possible exception of the saturated-core regulator, meet the conditions, and there is unquestionably a great need for the development of a simple and fairly cheap means of automatically changing taps and ratios on transformers under load. This problem can generally be best solved today by a combination of ratio changers and regulators or by a combination of ratio changers and synchronous condensers. The necessary amount of synchronous-condenser capacity needed to make the required amount of interchange energy feasible is one of the problems to be solved.

(c) Standardization of frequency. If large systems are to operate satisfactorily in parallel, it is essential that more thought be given to problems of frequency regulation and governors. At present closely situated systems (not interconnected) operating at what is nominally the same frequency may have as much as one to two cycles difference between them, and the governors on the large units in very many stations may be arranged so that it is almost impossible to operate the systems satisfactorily in parallel and obtain a close adjustment of load between them. It is important to check this point and take the necessary steps to insure that the governing facilities are sufficiently well adjusted to make it possible to operate the systems at the same frequency and permit at the same time load adjustment on each machine over the entire range of rating without affecting the frequency in any way. In this connection the synchronizing power of interconnecting lines is essential to satisfactory operation of systems in parallel.

(d) The possibilities of future interconnection between two systems at some other point should be taken into account and the transformer connections laid out so that future paralleling at any point will be possible without the necessity of introducing special transformers to straighten out phase displacements.

(e) Standardization of voltage, while desirable, is not essential, because systems of appreciably different voltage can be tied together by auto-transformers, and if the voltage difference is only in the neighborhood of 10 per cent, synchronous condensers will permit paralelling them.

6. *Metering.*—Up to 132,000 volts metering presents no difficulties at the present time as current and potential transformers for this voltage have been developed and are now in commercial operation. Metering of wattless component, especially where it is desired to measure both lagging and leading current for both directions of flow of power, can be handled by the use of standard meters and relays now available. However, it is essential that the scheme of billing which may be proposed for such an interconnection should be laid out with the complete metering scheme in mind, so that when the contract is in force no difficulties will be encountered in interpreting it.

7. *Switching and Relaying.*—Only by treating the switching scheme from the relaying point of view can satisfactory operation result.

8. *Dispatching.*—It is essential that a centralized load dispatching point be established in the operation of interconnected systems. Very often the tendency in a group of interconnected plants is for each plant to try to make as good a showing as possible without giving a thought to the benefits of the system as a whole. As a result the system suffers. With a central load dispatcher endowed with authority to direct the superintendents of each plant as to what loads they shall carry, the greater benefits and advantages are effected. To facilitate this dispatching a proper communication system is essential. This will not only insure carrying out instructions under normal conditions, but will make it possible to re-establish normal conditions after the occurrence of some severe disturbance. The communication system must be so designed that it is available in time of distress. Telephone wires strung under the transmission lines will not insure this result, and the only solution now in sight is apparently the carrier-current system.

9. *Cost of Interconnection.*—The cost of interconnection, including the lines, must be closely estimated and balanced against the amount of capacity which it makes available under both normal and emergency conditions, and also against the cost of providing such capacity by the installation of new generating equipment. Should the costs be equal, the decision should generally be made in favor of the interconnection, since the advantages of avoiding energy concentration at a point perhaps already overconcentrated and the advantage of being able in an extreme emergency to obtain energy from some outside source which would probably not be affected by the disturbance would be profitable.

In conclusion, the trend of development seems to be toward the consolidation of all power companies into regional groups with interconnecting points between them. These interconnections, however, in no case will be large enough to handle any great quantities of power from any great distance. Their object is more to make possible a successive transfer of power between adjacent points so that a distant point may receive relief.

Place of the Holding Company

Makes It Possible to Mass Credit, Financing Power, Engineering Skill and Managerial Ability Behind Service—Holding-Company Mechanism Essential to Majority of Utility Consolidations and Regroupings

By JOHN J. O'BRIEN
President H. M. Byllesby & Company

THE holding company is indispensable to proper utility development throughout the United States. This has been the case for the past twenty-five years. Present and future demands still further intensify the need for the holding company. In fact, outside of a few great centers of population we cannot get along without such organizations.

There is at present being carried out a considerable rearrangement and grouping of utility properties, particularly in the electric light and power industry. Smaller properties are becoming parts of larger systems. In a sense the power companies are being still further shaped into geographical units wherein the most can be accomplished in efficiency, economy and dependable service, somewhat along the lines mapped out for the steam-railroad lines. Moreover, such consolidations usually permit the supplying of service from transmission lines to additional people and industries. Not infrequently they enable the building of new water powers and steam plants. Altogether they are decisive steps in a constantly widening and improving public service of the greatest importance.

Lack of the holding-company mechanism would prevent the majority of utility consolidations and regroupings. Through the holding company we can mass credit, financing power, engineering skill and managerial ability. It is the only available medium whereby the common-stock equity capital can be obtained for the consolidation and growth of utility properties and at the same time the common-stock equity risk averaged

Important Mergers of Central Station Systems During 1924

Companies Involved	Territory Covered	Capitalization of Companies Involved	Date of Merger
Albert Emanuel Co., Inc.: Choctaw Utilities Co.	In Pittsburgh and Latimer Counties, Okla.		*Mar.
American Power & Light Co.: Miami Beach Electric Co.	Miami Beach, Fla.		*Mar.
Southern Utilities Co.	Florida		*Oct.
Miami Electric Light & Pr. Co.	Miami and vicinity		*Nov.
Miami Water Co.			*Nov.
Daytona Public Service Co.	Daytona, Fla., and vicinity		*Nov.
Central Arizona Light & Pr. Co.	Phoenix and vicinity		*Nov.
Arkansas Light & Power Co.: Arkansas Utilities Co.	Properties in Clarendon, Brinkley and Cotton Plant, Ia.		*Aug.
Arkansas-Missouri Power Co.: Campbell Electric Co.	Campbell & Clarkton, Mo.		*Sept.
Clarkton Dunklin Co.			
Atlantic City Electric Co.: Cape May County Elec. Co.; Cape May Light & Power Co.; Hammonton Electric Co.; West Jersey Electric Co.	Several towns in Southern N. J.	Over $9,000,000	*April
Badger Light & Power Co.: Wood County Light & Pr. Co.	Wisconsin		*Aug.
Bangor Hydro Electric Co.: Bangor Railway & Elec. Co.; Bar Har. & Union R. Pr. Co.; Bangor Power Co.; Lincoln Light & Power Co.	Eastern Maine	†10,000,000	*June
W. S. Barstow & Co.: So. Carolina Gas & Elec. Co.	Spartanburg, S. C., and vicinity		*July
Binghamton Lt., Heat & Pr Co.: Newark Valley Municipal	Newark Valley, N. Y.	†$20,000	
Sayre Electric Co.	Sayre, Penna. and vicinity		
Susquehanna Cy. Lt. & Pr. Co.	Susquehanna (Pa.) and vicinity		*July
Berkshire Delec Ltg. Co., Inc.	Town of Berkshire		Oct. 31
H. M. Byllesby & Company: Sierra & San Francisco Pr. Co.			*Aug.
Calumet Gas & Electric Co.: Knox Electric Light & Pr. Co.; Monterey Light & Pr. Co.; North Judson Electric Co.; Plymouth Elec. Lt. & Pr. Co.; La Grange Cy. Lt. & Pr. Co.; Valparaiso Lighting Co.; Consumer's Electric Co.; Demotte Utilities Co.; Hanna Light & Power Co.; Kankakee Valley Electric Co.; Kingsbury Light & Pr. Co.; Union Electric Co.; Wanatah-La Crosse Elec. Co.; Elkhart Gas & Fuel Co. (gas only)	Indiana	Total value of properties, $3,568,500	*Sept.
Carolina Power Co.: Ashboro Municipal	Ashboro, N. C.		*Sept
Carolina Power & Light Co.: Smitherman Power Co.; Deep River Pr. & Light Co.; Pittsboro Municipal; Ellerbe Municipal; Sandhill Power Co.	In southern North Carolina		*Sept
Central Illinois Public Service Co.: Greenview Elec. Lt. & Pr. Co.	Greenview, Sweetwater and Carrier		*Aug.
Carrier Mills Utilities Co.	Mills, Ill.		
Central Iowa Pr. & Light Co.: Citizens' Gas & Electric Co.	New company to operate in 13 counties in Iowa		*Nov
Cedar Valley Electric Co.			
Northern Iowa Gas & Elec. Co.			
Central Kansas Public Ser. Co.: Electric and ice installations in Plainville and Ellsworth, Kan.	Plainville, Ellsworth, Kan., and vicinity		
Central Maine Power Co.: Lincoln County Power Co., Inc.	11 towns in Maine	†$200,000	Mar. 6
Central Power & Light Co.: Mammoth Springs Elec. Light & Power Co.	Mammoth Springs, Ark., and vicinity		*Nov.
Cities Service Co.: Consumer's Lt., Heat & Pr. Co.	Topeka, Kan		*May
Community Pr. & Lt. Co. of St. Louis: Electri Light and power plants in Versailles, Eldon, Tyston and California, Mo.	4 towns in Missouri		*May
Connecticut Electric Syndicate: New Milford Elec. Light Co.	New Milford, Conn	$150,000	*Sept.
Consumer's Power Co., Osage, Ia.: Alta Vista (Iowa) Municipal	Alta Vista, Iowa		*Sept.
Consumer s Pr. Co., Jackson, Mich. Ovid municipal	Ovid, Mich		*June
Continental Gas & Electric Co.: Columbus Ry., Lt. & Power Co.	Columbus, Ohio	Over $9,000,000	June
Kansas City Pr. & Light Co.	Kansas City, Mo	†$10,000,000	Jan.
Lincoln Traction Co.	Lincoln, Neb.		*Sept.
Doherty Operating Co.: Northwestern Ohio Ry. & Pr. Co.	Towns in Toledo district	$,500,000	*Oct.
East Texas Public Service Co.: Marshall Electric Co.; Jefferson Ice & Light Co.; Longview Ice & Light Co.; Cason Electric Light & Pr. Co.; Gilmer Ice & Light Co.; Mineola Ice, Light & Water Co.; Winnsboro Ice & Light Co.; Grand Saline Light & Pr. Co.; Also electric properties at Atlanta, Alba, Daingerfield, DeKalb, New Boston, Hughes Springs, Linden, Mount Vernon, Naples and Quitman	Texas	$1,200,000	May 1

Important Mergers of Central Station Systems During 1924 (Continued)

Companies Involved	Territory Covered	Capitalization of Companies Involved	Date of Merger
Eastern Texas Elec. Railway Co.: Lake Charles Municipal	Lake Charles, La	†$1,000,000	*Aug.
El Paso Electric Railway Co.: Las Cruces Light & Ice Co	Las Cruces, N. M., and vicinity	†$275,000	*May
Florida Public Service Co.: Orlando Public Service Co	21 communities in central Florida		*Feb.
Orlando Gas Co.			
Florida Ice & Power Co.			
De Land Elec. Lt., Pr. & Ice Co.			
Eustis Light & Water Co.			
A. E. Fitkin & Co.: Tarpon Springs Elec. & Ice Co	Tarpon Springs, Fla., and vicinity		*Aug.
Fulton County Gas & Elec. Co.: Middleburg & Schoharie Elec. Co.	Eastern New York State		Sept.
Great Bear Elec. Light Co.			
Worcester Elec. Light Plant			
Gen. Eng. & Management Corp.: Arkansas-Missouri Power Co	Southeast Missouri and Northeast Ark.		
Boyne City Electric Co	Boyne City, Mich.		
Boyne River Power Co	Boyne City, Mich.		
General Gas & Electric Corp.: North Carolna Pub. Ser. Co	Greensboro, N. C., and vicinity		*Feb.
Georgia Railway & Power Co.: Wofford Shoals Pr. & Lt. Co	Habersham & Hall Counties		Jan.
Panola Light & Power Co	Towns of Conyers and Lithonia		April
Great Western Power Corp.: San Joaquin Lt. & Pr. Corp.	In San Joaquin Valley and South Central Coast counties		Dec. 2
Midland Counties Pub. Service Corp.			
Fresno City Water Corp.			
Mrs. D'Arline Holcomb.: Rolla (Mo.) municipal	Rolla, Mo.		*Nov.
Illinois Northern Utilities Co.: Rock Falls municipal	Rock Falls, Ill.		*Aug.
Illinois Power & Light Co.: Central Illinois Electric Co.	Several towns in Illinois		*April
Western Illinois Utilities Co.			*April
Columbia Municipal			*July
Cerro Gordo Electric Co.			*July
Argenta Warrensburg Elec. Co.			*July
Interstate Power Co.		$12,450,000 securities authorized	*Aug.
Southern Minn. Gas & Elec. Co.	Northern Iowa and Minnesota		
Interstate Power Co	Northeast Iowa and Southwest Wisconsin		
Bloomington Elec. Lt. & Pr. Co.	Bloomington, Wis., and vicinity		
Gays Mills Electric Co.	Gays Mills, Wis.		
Soldiers' Grove Electric Co	Soldiers' Grove, Wis.		
Austin Gas Co	Austin, Minn.		
Prairie City Electric Co	Prairie-du-Chien, Wis.	†$200,000	
Madelia Electric Co	Madelia, Minn.		
North Central Electric Co.	Wisconsin		
Interstate Utilities Corp.: Oconee River Mills Elec. Prop	Milledgeville, Ga		*Sept.
Ocklawaha Power Co.			
Iowa Electric Co.: Keosauqua municipal	Keosauqua, Iowa		*Aug.
Iowa Electric Light Co.: Hopkinton Elec. Lt. & Pr. Plant	Hopkinton, Iowa		*Nov.
Iowa Southern Utilities Co.: Iowa Light, Heat & Pr. Co	8 towns in Southeast Iowa		*July
(Property in vicinity of Grinnell only)			
Burlington Railway & Lt. Co	14 towns in Southeast Iowa		*Aug.
Iowa Gas & Electric Co	22 towns in Southeast Iowa		*Oct.
Jersey Central Pr. & Lt. Corp.: Tri-County Electric Co.	Pompton Lakes and vicinity		
Consolidated Gas Co. of N. J.	Long Branch and coast towns		
Shore Gas Co.	Belmar, Lakewood and vicinity		
Lakewood Gas Co			
Ocean City Gas Co	Ocean City		
Kennett Gas Co.	Kennett Square, Pa.		
Kansas Pub. Service Co.: Topeka Railway & Light Co.	Kansas	Over $13,000,000	*April
Atchison Ry., Lt. & Pr. Co.			
Wichita Railway & Light Co.			
Topeka Edison Co.			
Topeka Railway Co.			
Kansas Power & Light Co.			
Kentucky-Tennessee Lt. & Pr. Co.: Kentucky River Utilities Co	Ravenna-Irvine, Ky.		*Feb.
Martin Municipal	Martin, Ky.	†$82,775	*May
Dresden, Union City, Dyer and Sharon Municipal plants	Tennessee		*May
Kentucky Utilities Co.: Old Dominion Power Co	Norton, Va., and vicinity		*Sept.
Kewanee Public Service Co.: Kewanee municipal: also Elec. and gas plants and railway and interurban systems	Kewanee, Ill.	$2,000,000	June 14

Companies Involved	Territory Covered	Capitalization of Companies Involved	Date of Merger
Lake Superior Dist. Electric Co.: Medford Light & Heating Co	Medford, Wis.		*Feb.
Washburn Elec. Light & Pr. Co.	Washburn, Wis.		*Feb.
Lincoln Gas & Electric Co.: Lincoln Traction Co	Lincoln, Neb.		*Oct.
Minnesota Electric Lt. & Pr. Co.: Cass Lake Water, Lt. & Pr. Co.	Cass Lake, Minn.		*April
Eastern Montana Lt. & Pr. Co.	Glendive, Mont., and vicinity		
Minnesota Power & Light Co.: Park Rapids Hydro. Plant	Park Rapids, Minn.		*Aug.
Mississippi Power & Light Co.: Tupelo municipal	Tupelo, Miss.		*July
Baldwin municipal	Baldwin, Miss.		
Missouri Power & Light Co.: Jefferson City Lt., Heat & Pr. Co.	Jefferson City, Mo.		*Mar.
Missouri Utilities Co.	12 towns in Missouri		*Mar.
Northern Missouri Light & Power Co (Properties from Hannibal down the river only).			*Mar.
North Amer. Lt. & Pr. Co. (Properties in Ohio and Okla. only).	Ohio and Oklahoma		*Mar.
North Missouri Power Co	50 cities and towns in northern Mo.	$2,800,000 = value	*June
Mountain States Power Co.: Stayton Light & Power Co	Stayton, Ore.		*Sept.
National Power & Light Co.: Birmingham Ry. Lt. & Pr. Co. (name changed to Birmingham Electric Co.)	Birmingham, Ala., and vicinity	†$18,500,000	*Mar.
New Hampshire Power Co.: Canaan-Enfield Electric Co.	New Hampshire		*Jan.
Hillsboro Elec. Lt. & Pr. Co.			
Lake Sunapee Power Co.			
Also Newport, Sunapee, Contoocook and Antrim—Bennington Electric Lt. companies			
New York Central Elec. Corp.: Perry Electric Light Co	New York State southeast of Rochester		*Jan.
Warsaw Gas & Electric Co			*Jan.
Hornell Electric Co.			*Jan.
Dansville Gas & Electric Co.			*Jan.
Yates Electric Light & Pr. Co.			*Jan.
Wayne Power Co.			*Jan.
Arkport (N. Y.) municipal			*Aug.
Canaseraga Electric Co.			*Aug.
Distributors Electric Co.			*Aug.
New York State Gas & Elec. Corp.: Madison Power Co., Inc.	South central part of New York State		*Mar.
Moravia Elec. Lt. & Power Co.			*Mar.
Delaware County Lt. & Pr. Co.			*Mar.
Waterville Gas & Electric Co.			*Mar.
West Branch Lt. & Power Co.			*Mar.
Sullivan Cy. Light & Pr. Co.			*Mar.
Southern New York Pr. Co.			*Mar.
Fleishmanns Lt., Heat & Pr. Corp.			*Mar.
New Berlin, Light & Power Co.			*Mar.
Pine Hill electric property			*Mar.
Callicoon Independent El. Co.			*Mar.
Tri-County Lt. & Pr. Co			*Mar.
Livingston Manor			*Aug.
Seely Electric Co.			*Aug.
Liberty Light & Power Co			*Sept.
North American Co.: Peninsular Power Co	Northeast Wisconsin and upper peninsula Michigan	$2,752,500 (outstanding)	*Nov.
North Carolina Pub. Ser. Co., Inc.: Piedmont Power & Light Co	Alamance Co., N. C.	Value, $1,500,000	*June
Northeastern Iowa Power Co.: Consumers Power Co	75 communities in 13 counties in Iowa	$1,500,000	Nov. 1
People's Power Co.			
Calmar Electric Co.			
Northern Adirondack Power Co.: J. J. Rogers Co., Ausable Forks, purchased above—to retain name			*Aug.
Northern New York Utilities, Inc.: Rome Gas & El. Lt. & Pr. Co			*May
Northern States Power Co.: St. Cloud Public Service Co.	Approximately 50 towns in Minn.	†Over $3,500,000	*Aug.
Northwest Arkansas Utilities Co.: Fayetteville Gas & Electric Co.	Fayetteville, Ark.		*Feb.
Rogers Light & Water Co.	Rogers, Ark.		
Springdale Light & Power Co.	Springdale, Ark.		
Northwestern Public Service Co.: Mitchell Power Co	Mitchell, S. D., vicinity		*Mar.
Huron Light & Power Co.	Huron, S. D.		*Mar.
Consumers Utility Co.	Armour, S. D., and vicinity		*Aug.
Ohio Edison Co.: Springfield Lt., Heat & Pr. Co.	Springfield, Ohio, and vicinity		*Mar.
Ohio Electric Power Co.: Oberlin Gas & Electric Co.	Oberlin, Ohio		*Aug.
Ravenna Gas & Elec. Light Co.	Ravenna, Ohio		
Oklahoma Power Co.: Okemah Municipal	Okemah, Okla.		*Nov.
Otter Tail Power Co.: Midwest Power Co.	9 counties in North Dakota	†$150,000	*Aug.
Tri-State Power Co.		†$27,000	
Western Electric Co.		†60,000	

Important Mergers of Central Station Systems During 1924 (Continued)

Companies Involved	Territory Covered	Capitalization of Companies Involved	Date of Merger
Pacific Gas & Electric Co.:			
Amador Elec. Light & Pr. Co.	Amador County, Cal.	$150,000	Feb. 1
Penn. Central Light & Pr. Co.:			
Home Electric Co.	Tyrone, Pa.		Dec. 1
Logan Valley Railway Co. (supplied with current by Penn. Cen. L. & P. Co.)	Tyrone, Pa.		
Pennsylvania Power & Light Co.:			
Citizens Light & Power Co.	Hughesville, Pa.		*Jan.
Public Service Co. of Colorado:			
Colorado Power Co.	Colorado cities		*Aug.
Public Service Company of Mo.:			
California Electric Light Co.	6 towns in Missouri.	†$210,500	*July
Versailles Light & Power Co.	2 towns in Missouri.		
Harvey Light, Power & Ice Co. / Eldon Ice & Fuel Co.	Eldon, Mo.	†$194,500	.....
Caldwell Municipal	Caldwell, Mo.	†$108,500	.....
Public Service Company of Okla.:			
Tulsa Light & Power Co.	Tulsa, Okla.		*Nov.
Public Service Electric & Gas Co.:			
Public Service Electric Co.			July 25
Public Service Gas Co.			
Puget Sound Power & Light Co.:			
Puget Sound International Ry. & Pr. Co. (Business, light and power dept. only.)	Everett, Wash.		Jan. 1
Pacific Northwest Trac. Co.	Communities between Seattle and Everett.		Jan. 1
(Physical property and business of light and power department only in Snohomish County.)			
Olympia Light & Power Co. (Property and business.)	Olympia, Wash.		Mar. 31
North Coast Power Co. (Property and business except street railway in Vancouver.)	Chehalis, Tenino and Kelso, Wash., and Hillsboro, Ore., and vicinity.		April 30
Washington Coast Utilities	8 towns in Wash.		May 31
Puget Sound Elec. Railway Co. / Tacoma Railway & Power Co.	Kent, Auburn, Tacoma and vicinity.		May 31
(Light and power physical properties only)			
Pacific Northwest Traction Co.	Skagit County.		July 31
Washington Pr., Lt. & Water Co. (Physical property, light and power department only.)	Anacortes, Wash.		Nov. 1
Rockland Light & Power Co.:			
Orange County Pub. Ser. Co., Inc.	Orange County, N.Y.		*Sept.
St. Lawrence Valley Pr. Corp.:			
Hannawa Falls Water Pr Co.	Hannawa Falls, N.Y.		*May
L. R. Schlecter of Sioux City, Ia.:			
Alvord municipal	Alvord, Iowa.		*Oct.
South County Pub. Service Co.:			
Westerly Electric & Power Co. / Wickford El. Lt. & Water Co. / Narragansett Pier Electric Lt. & Power Co.	Rhode Island.	$850,000	.....
Southeastern Pr. & Light Co.:			
Alabama Trac. Lt. & Pr. Co.			Oct. 10
Southern Cities Power Co.:			
Columbia Water & Light Co.	Columbia, Tenn.	†$500,000	*Sept.
Southwestern Light & Pr. Co.:			
Walters municipal	Walters, Okla.		*Aug.
Southwest Power Co.:			
Choctaw Power & Light Co.	McAlester, Okla.		*June
Coal District Power Co.	Huntington, Ark.		
Tennessee Electric Power Co.:			
Nashville Railway & Light Co.	Tennessee.		*Feb.
Chattanooga Ry. & Light Co.			*Feb.
Chattanooga & Tenn. R. Pr. Co			*Feb
Tennessee Power Co.			*Feb.
Tennessee Ry., Light & Pr. Co.			*Feb.
Tennessee Electric Power Co.			*Feb.
Nashville Trust Co.			*Feb.
Davidson Light & Power Co.			*Sept.
Tennessee Electric Power Co.:			
Maryville Lighting Co. / Cumberland Power Co. / Madisonville Light & Pr. Co. / Lenoir City Light & Power Co.	Tennessee.		*Nov. / *July / *July / *July
Texas Central Power Co.:			
Gonzales Electric Light Co. / Gonzales Water Power Co.	Gonzales, Texas.	†$500,000	*Nov.
Texas Power & Light Co.:			
Cooper Power & Light Co.	Cooper, Tex.		*Oct.
Decatur municipal	Decatur, Tex.		
Texas Public Utilities Co.:			
Brenham Elec. Lt. & Pr. Plant	Brenham, Tex.		*Nov.
Tidewater Power Co.:			
Warsaw municipal	Warsaw, N. C.		
Burgaw municipal	Burgaw, N. C.		
Whiteville municipal	Whiteville, N. C.		
Tarpon Springs El. & Ice Prop.	Tarpon Springs, Fla.		
Toledo Edison Co.:			
Defiance Gas & Electric Co. / Swanton Light & Power Co. / Holgate Light & Power Co.	Vicinity of Toledo, Ohio.	†$4,007,500	*June
Utah Power & Light Co.:			
Evanston Electric Light Co.	Evanston, Wyo.		*Jan.
Warm Springs Power Co.	Ashton, Idaho, and vicinity.		*Aug.
United Light & Power Co.:			
Continental Gas & Elec. Co.	Iowa, Illinois, Indiana, Michigan, Missouri, Kansas, Nebraska and Ohio.		*Oct.
United Power Co. of Oklahoma.:			
Electric Properties in Helena, Jet, Nesh, Goltry, Meno, Lahoma, Kremlin, Pond Creek and Jefferson.	Oklahoma.		*Aug.
Utilities Power & Light Corp.:			
Dubuque Electric Co.	Dubuque, Iowa, and vicinity.		*Oct.
Washington Coast Utilities Co.:			
Tumwater Light & Water Co. (Physical property and business of light and power department only.)	Leavenworth, Wash. and vicinity.		Feb. 28
Western New York Electric Co.:			
Sherman municipal	Sherman, N. Y.		*Aug.
Western United Corp.:			
Aurora Elgin & Fox R. El. Co.	Elgin, Ill.		Jan. 1
West Missouri Power Co.:			
Fort Scott & Nevada Light, Heat, Water & Power Co.	Nevada, Mo.		*June
Sac River Power & Light Co.	Towns between Kansas City and Nevada, Mo.		*June
West Penn Co.:			
Clarksburg Gas & Electric Co.	Clarksburg, W. Va. and vicinity.		Jan. 7
Buckhannon Light & Water Co.	Buckhannon, W. Va. and vicinity.		*Sept.
West Texas Utilities Co.:			
Interstate Electric Corp.	San Angelo, Tex.	†$1,500,000	*Nov.
J. G. White Co.:			
Carolina Light & Power Co.	Aiken, S. C.		*Oct.
Wisconsin Power & Light Co.:			
Eastern Wis. El. Co. of Madison / Badger Electric Co. / Janesville Electric Co. / Wisconsin Pr., Lt. & Heat Co. / Mineral Point Pub. Service Co. / Wisconsin Utilities Co. / Middle Wisconsin Power Co.	Eastern Wisconsin		*April.
Wisconsin Public Service Corp.:			
De Pere Light & Power Co.	De Pere, Wis.	$150,000	*June 1
Oconto Electric Co.	Oconto, Wis.		Oct. 1

† Purchase price or value. * Date reported or announced.

over diversified situations. In this way a safe investment can be offered to the public backed by the common stock of operated properties, leaving the way clear for major financing by senior securities of the properties. The strong utility-holding companies are destined to grow steadily, and it is to be expected that new ones will come into the field as the necessity arises.

It should not be supposed that the mere form of a holding company is an assurance of either technical or financial success. Back of any such corporate structure must exist highly specialized ability, proved responsibility and constructive experience. The place that the utilities enjoy today in public confidence is no accident. They have won their present standing because of the lifework of many individuals devoted to their upbuilding. Poorly conceived and badly handled holding companies cannot stand up any better than other corporate edifices reared on weak foundations.

As a whole, however, it is true that utility-holding companies have been deserved financial successes. They have made their way steadily in the face of discouraging circumstances and a lack of recognition of the vital part they have had in utility development. Were it not for their instrumentality many cities and towns would be far behind their present stage of utility development, and, after all, the basic reason for the financial success of any undertaking is the real need for its existence.

During every period of financial stress the holding companies have proved bulwarks of strength to the properties in which they owned investments. The bondholders and stockholders of operating properties might have had opportunity to regret their investments had it not been for the financial, engineering and operating services of the holding companies. In numerous instances an acceptable investment in the

property itself could not be made were it not for the holding company back of it. On the other hand, it is next to impossible to provide a really first-class, senior direct property security without correspondingly enhancing the value of the junior securities owned by the holding company.

By the character of their management the competent holding companies have established credit capacities and reputations of the utmost value to the operated properties. They have been able to advance funds and see the properties through the satisfactory results which depended only on good management and a proper supply of capital at times when they could not obtain the money individually and for themselves.

Many Important Mergers During 1924

THE year 1924 has witnessed more important mergers of central-station systems than any previous year in the history of the industry. The tendency toward centralization of the control of light and power companies which was evidenced in the 1922 "Census of Central Stations," a portion of which has been made public, is stronger today than ever before. As a result of the mergers of the past two years it is probable that the number of operating systems in the country has been reduced very close to six thousand, although the census reported 6,355 operating companies on January 1, 1923.

Some of the mergers included in the tables on pages 27, 28 and 29 involve large systems, but for the most part the companies entering into the mergers are local in character. The inclusion of a considerable number of municipal systems is to be noted, especially in the South Atlantic and North Central States. Mergers took place in all sections of the country, however, indicating that the tendency toward centralization of control in the central-station industry is nation-wide.

There were without doubt other mergers that took place during 1924 which are not listed in the accompanying tabulation, but it is believed to contain all the outstanding mergers which took place during the year. Efforts were made to obtain complete information as to the capitalization of the companies involved in the mergers, but in only a few cases was this information forthcoming.

Central-Station Load Analyzed

Iron and Steel Industry Leads in the Consumption of Electrical Energy—Distribution of Load Varies Widely in Different Sections of the Country, the Middle Atlantic States Being First in Total Utilization

BY MEANS of the various five-year surveys of the United States Census Bureau very clear pictures of the growth and status of the central-station industry of each census year have been given. These pictures, however, have necessarily been general in nature and have not attempted to delve into the detailed operations of the industry. The Census for 1922, recently issued, has presented more details of the activities within the industry than any previous census; but it does not attempt any detailed segregation of the distribution of central-station energy for light, transportation and among the various primary industries of the country. With a view to arriving at as clear a picture as possible of the actual and relative use of central-station energy by the various industries, the ELECTRICAL WORLD during the past year has gathered distribution statistics from as many central-station companies as could furnish them and, with other ELECTRICAL WORLD and Census Bureau data as a basis, has estimated the distribution of the 1923 central-station load. This estimate is set forth in the accompanying tables.

In any study of this nature the more detailed the data the more liable are they to be subject to correction. For instance, it is perfectly possible to arrive at the amount which the average family spends for household expenses during the year, but it is an entirely different matter to ascertain what proportion of this amount is spent for coffee, eggs, meat, potatoes, etc., since every family has its individual tastes and desires. Similarly, conditions in the central-station industry vary widely in each section of the country. Assumptions which would prove perfectly correct for the country as a whole might not indicate in any way conditions in some one section and still less conditions in a certain state, a city or county of that state. Hence, in making this study the use of electrical energy by the various industries and the proportion of the energy generated which was used for lighting, power and railways have been governed by conditions in the various sections as indicated by the distribution reports received from the central stations.

In order that a correct orientation may be given to the various primary industries using central-station energy, data are included in the accompanying tables giving the total number of manufacturing plants, mines and wells, including those using central-station energy; the total number of employees in these plants and the total value of products manufactured or mined. With these as guides many interesting comparisons can be made as to the use of electrical energy by the various industries of the United States.

Proportion of Energy Generated in Hydro Plants on the Increase

In studing the distribution of central-station energy three phases must be covered—the generation of the energy, the transmission of the energy from the power house to the actual consumer, and the ultimate consumption of the energy as light, heat or power. The amount of electrical energy generated by the central-station industry during 1923 is estimated at 50,887,203,000 kw.-hr. The proportion of this energy generated by hydro-electric plants was 34.8 per cent of the total, and a study of energy generation for the past few years indicates a continued decrease in the proportional amount generated by these plants. It is possible that the proportion of energy generated by hydro plants will increase slightly as some of the large plants being constructed under licenses from the Federal Power

Table I—Distribution of Central-Station Energy Between Light and Power During 1923

Section	Number of Central-Station Customers (Jan. 1, 1924)			Total Energy Generated by Central Stations During 1923, Kw.-Hr.	Energy Used in Intra-company Business and Line Losses, Kw.-Hr.	Distribution of Energy (1923)			
	Residential Lighting	Commercial Lighting	Industrial Power			Total Energy Consumed by Central-Station Customers, Kw.-Hr.	Energy Consumed for Lighting, Kw.-Hr.	Energy Consumed for Power, Kw.-Hr.	Energy Sold to Electric Railways, Kw.-Hr.
United States	11,724,023	2,262,755	533,313	50,887,203,000	9,827,000,000	41,060,203,000	11,201,500,000	23,930,458,000	5,928,245,000
New England	1,066,510	224,260	45,689	3,654,896,000	785,000,000	2,869,896,000	841,000,000	1,620,096,000	408,800,000
Middle Atlantic	2,567,420	538,580	95,913	12,940,696,000	2,393,000,000	10,547,696,000	3,345,000,000	5,709,696,000	1,493,000,000
South Atlantic	756,276	164,970	32,591	5,550,555,000	1,026,000,000	4,524,555,000	687,000,000	3,395,555,000	442,000,000
East North Central	3,211,630	561,860	124,168	12,046,252,000	1,950,000,000	10,096,252,000	2,615,000,000	5,461,252,000	2,020,000,000
West North Central	1,334,607	251,100	62,624	3,556,824,000	576,000,000	2,980,824,000	1,277,000,000	1,597,699,000	106,125,000
East South Central	377,620	73,325	19,806	1,825,728,000	398,000,000	1,427,728,000	324,000,000	807,728,000	296,900,000
West South Central	721,030	121,920	32,825	1,548,143,000	337,500,000	1,210,643,000	414,000,000	629,823,000	166,820,000
Mountain	419,920	67,080	21,530	2,716,503,000	656,500,000	2,060,003,000	361,500,000	1,513,803,000	184,700,000
Pacific	1,269,010	259,660	98,167	7,047,606,000	1,705,000,000	5,342,606,000	1,337,000,000	3,194,806,000	810,800,000

Table II—Distribution of the 1923 Central-Station Power Load in the United States

Industry	Total Number of Establishments (Including Those Using Central Station Energy) Jan. 1, 1922 **	Average Number of Wage Earners 1921 **	Total Value of Products Manufactured, 1921 **	Electrical Energy Sold by Central Station Companies to Various Industries During 1923, Kw.-Hr.	Estimated Sum of Central-Station Customers' Maximum Power Demands During 1923, Kw.	Estimated Number of Motors in Manufacturing Plants, Mines, on Farms and in Buildings (Elevators, etc.) Using Central-Station Energy
Agricultural implements	2,520	71,693	$311,338,000	73,039,000	49,970	5,364
Chemicals and allied products (total)	10,600	400,509	4,813,841,000	5,121,467,000	1,366,720	96,366
Rubber and rubber products	663	79,215	614,620,000	524,442,000	246,230	15,236
Glass and glass products	933	71,037	276,734,000	120,347,000	70,880	8,860
Chemicals	4,867	82,050	862,117,000	688,325,000	282,670	28,250
Smelting and refining of metals	114	13,215	378,330,000	1,050,530,000	306,200	7,850
Artificial-gas manufacture	1,280	34,199	362,840,000	156,983,000	50,610	3,740
Miscellaneous chemical industries	2,743	120,793	2,319,200,000	2,580,840,000	430,130	32,430
Electrical equipment and machinery	1,333	161,204	833,985,000	431,588,000	215,150	50,235
Food and kindred products	49,503	604,108	8,141,787,000	1,657,200,000	1,016,270	148,670
Iron and steel and their products	14,058	959,830	5,289,955,000	3,193,050,000	1,573,210	182,050
Leather and its products	4,813	280,071	1,544,185,000	242,255,000	170,520	29,780
Lumber and its products	20,273	675,069	2,429,513,000	593,170,000	356,190	58,900
Metals and metal products other than iron or steel	8,065	235,170	1,574,943,000	691,248,000	417,710	73,000
Mining (total)	†281,396	†964,095	‡3,103,902,427	2,467,991,000	1,552,950	55,375
Coal	†8,816	†693,170	‡1,510,061,707	1,071,700,000	828,750	31,600
Petroleum and natural gas	†268,508	†93,205	‡931,793,423	151,879,000	73,210	4,226
Iron ore	†406	†45,741	‡218,217,905	165,636,000	114,130	3,288
Copper	†226	†43,717	‡181,258,088	389,838,000	114,450	3,300
Lead and zinc	†473	†21,884	‡75,579,346	236,150,000	100,360	2,880
Gold and silver, lode mines	†799	†15,436	‡58,832,330	175,130,000	98,960	2,840
Gold, placer mines	†132	†1,380	‡9,368,561	52,985,000	38,650	1,110
Stone quarries	†1,919	†42,997	‡101,684,930	208,800,000	172,030	5,790
Phosphate rock	†69	†4,372	‡10,300,198	5,345,000	4,470	130
Gypsum	†48	†2,193	‡6,805,939	10,528,000	7,940	211
Paper	827	98,672	$786,707,000	811,895,000	363,330	50,500
Printing	24,528	368,400	2,362,040,000	307,200,000	276,320	192,000
Railroad-shop construction and repairs	2,326	418,285	1,267,343,000	648,870,000	370,100	30,450
Stone and clay and their products	7,363	179,775	741,870,000	1,466,180,000	394,790	27,300
Textiles	26,039	1,510,876	6,960,928,000	1,566,941,000	1,149,270	207,050
Vehicles for land transportation	3,590	281,350	2,508,655,000	714,693,000	634,060	106,440
*Miscellaneous	20,429	701,558	4,086,194,000	3,943,671,000	2,868,100	364,730
Totals all industries	477,663	7,910,665	46,757,186,427	23,930,458,000	12,794,660	1,678,210

*Includes all domestic heating, small commercial power and irrigation and pumping load.
**Includes only manufacturing establishments which reported products over $5,000 in value.
†As of January 1, 1920. ‡For year 1919.

Table III—Distribution of the 1923 Central-Station Power Load in the New England States

Industry	Total Number of Establishments (Including Those Using Central-Station Energy) Jan. 1, 1922 **	Average Number of Wage Earners 1921 **	Total Value of Products Manufactured 1921 **	Electrical Energy Sold by Central Station Companies to Various Industries During 1923, Kw.-Hr.	Estimated Sum of Central-Station Customers' Maximum Power Demands During 1923, Kw.	Estimated Number of Motors in Manufacturing Plants and Mines and in Buildings (Elevators, etc.) Using Central-Station Energy
Agricultural implements	96	1,430	$2,643,000	178,000	350	40
Chemicals and allied products (total)	767	40,055	341,390,000	132,917,000	95,400	6,430
Rubber and rubber products	127	21,490	113,800,000	94,250,000	67,500	4,180
Glass and glass products	6	264	1,450,000	417,000	350	40
Chemicals	335	4,250	48,500,000	12,100,000	10,650	1,060
Smelting and refining of metals	1	196	6,080,000	4,430,000	2,830	70
Artificial-gas manufacture	138	4,130	47,560,000	10,600,000	6,930	520
Miscellaneous chemical industries	160	9,725	124,000,000	11,120,000	7,140	560
Electrical equipment and machinery	186	27,668	113,683,000	31,800,000	23,400	5,270
Food and kindred products	2,950	39,250	392,000,000	48,700,000	35,850	5,140
Iron and steel and their products	2,765	108,200	392,500,000	171,700,000	136,500	15,780
Leather and its products	1,368	103,500	514,120,000	74,800,000	59,600	10,480
Lumber and its products	2,090	38,450	153,000,000	31,500,000	26,600	4,400
Metals and metal products other than iron or steel	1,600	113,750	619,920,000	121,200,000	80,700	14,470
Mining (total)	†291	†7,012	‡18,212,273	36,617,000	33,370	1,110
Copper	†2	†181	‡388,310	1,897,000	1,670	50
Stone quarries	†289	†6,831	‡17,823,963	34,720,000	31,700	1,060
Paper	228	30,400	229,100,000	293,000,000	176,400	24,520
Printing	1,852	31,870	189,500,000	21,600,000	21,000	14,580
Railroad-shop construction and repairs	120	15,560	9,940,000	19,450,000	15,350	1,250
Stone and clay and their products	355	4,515	12,960,000	18,100,000	11,280	780
Textiles	2,472	403,500	1,665,000,000	399,000,000	351,000	63,300
Vehicles for and transportation	278	10,480	82,930,000	15,680,000	14,470	2,420
*Miscellaneous	2,220	118,232	347,900,000	203,904,000	173,000	30,900
Total for all industries of New England	19,638	1,093,872	5,084,798,273	1,620,096,000	1,254,270	200,870

*Includes all domestic heating, small commercial power and irrigation and pumping load.
**Includes only manufacturing establishments which reported products over $5,000 in value.
†As of January 1, 1920. ‡For year 1919.

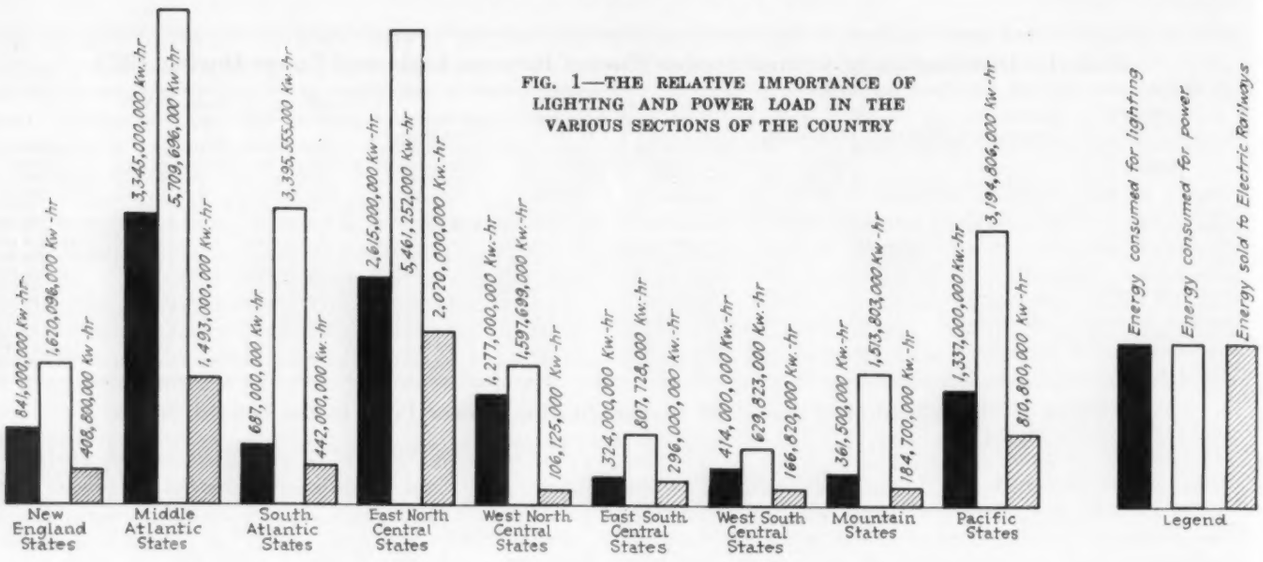


FIG. 1—THE RELATIVE IMPORTANCE OF LIGHTING AND POWER LOAD IN THE VARIOUS SECTIONS OF THE COUNTRY

Commission are put into operation. However, a close study of the figures of generation would tend to indicate that some of the sections of the country which have recently been increasing their load with the greatest rapidity are sections in which hydro-electric generation is a negligible quantity.

The three Middle Atlantic States produced the greatest amount of energy during 1923, being followed closely by the five East North Central States. Both of these sections are highly industrial and contain some of the largest centers of American population.

To the lay mind the fact that one million kilowatt-hours generated at the power plant does not result in the same amount of energy being delivered to the actual consumers is paradoxical. Line losses mean little or nothing to him, and yet 19.3 per cent, or nearly one-fifth, of the energy generated by the central stations of the country is lost in transmission. Some companies with very long transmission lines report line losses of more than 30 per cent. In studying the distribution of central-station load, therefore, line losses assume a position of considerable importance. The total energy lost in transmission during 1923 totaled 9,827,000,000 kw.-hr., which amount was greater than the total amount of energy generated in the West North Central, East South Central, West South Central and Mountain States combined. Increased efficiency in transmission engineering will, of course, tend to cut down the energy lost in transmission, but line losses must by all laws of force continue to be a large factor in the distribution of central-station energy.

The ultimate consumption of central-station energy falls under three classes—that used for lighting and small power (domestic, commercial, municipal and industrial); that used by electric railways (street, interurban and cross-country), and that used for industrial power purposes (manufacturing, mining, pumping and heating). In 1923 this ultimate consumption was distributed in the following proportions: 11,201,500,000 kw.-hr., or 27.5 per cent, for light; 5,928,245,000 kw.-hr.,

Table IV—Distribution of the 1923 Central-Station Power Load in the Middle Atlantic States

Industry	Total Number of Establishments (Including Those Using Central Station Energy) Jan. 1, 1922 **	Average Number of Wage Earners 1921 **	Total Value of Products Manufactured 1921 **	Electrical Energy, Sold by Central Station Companies to Various Industries During 1923, Kw.-hr.	Estimated Sum of Central-Station Customers' Maximum Power Demands During 1923, Kw.	Estimated Number of Motors in Manufacturing Plants and Mines and in Buildings (Elevators, etc.) Using Central-Station Energy
Agricultural implements	405	9,300	$34,750,000	6,180,000	4,820	520
Chemicals and allied products (total)	3,349	135,513	1,488,240,000	1,916,473,000	376,550	31,670
Rubber and rubber products	209	17,650	114,000,000	98,800,000	47,750	2,960
Glass and glass products	346	31,300	132,940,000	40,000,000	26,800	3,420
Chemicals	1,807	37,670	383,000,000	494,000,000	133,000	13,240
Smelting and refining of metals	16	2,353	72,900,000	58,450,000	23,600	600
Artificial-gas manufacture	268	12,340	146,400,000	2,223,000	1,400	100
Miscellaneous chemical industries	703	34,200	639,000,000	1,223,000,000	144,000	11,350
Electrical equipment and machinery	449	61,559	344,415,000	206,000,000	108,200	26,400
Food and kindred products	10,600	148,800	1,925,000,000	204,000,000	148,800	21,350
Iron and steel and their products	4,750	406,500	2,248,400,000	1,282,000,000	614,000	71,100
Leather and its products	1,758	85,585	507,100,000	59,900,000	36,400	6,400
Lumber and its products	3,160	54,200	278,200,000	61,500,000	50,000	8,300
Metals and metal products other than iron or steel	2,915	59,410	417,500,000	68,900,000	45,900	7,900
Mining (total)	†97,092	†331,258	‡847,909,421	301,930,000	270,930	9,980
Coal	†3,118	†302,364	‡727,058,093	236,000,000	212,000	8,100
Petroleum and natural gas	†93,362	†9,933	‡76,172,855	1,150,000	700	40
Gypsum	†6	†400	‡1,110,463	930,000	830	20
Lead and zinc	†6	†2,049	‡4,539,495	10,950,000	9,820	280
Iron ore	†21	†3,160	‡8,636,226	12,000,000	10,930	310
Stone quarries	†579	†13,352	‡30,392,289	40,900,000	36,650	1,230
Paper	278	25,060	211,500,000	230,000,000	113,000	15,720
Printing	6,810	128,850	896,900,000	73,400,000	90,000	62,500
Railroad-shop construction and repairs	450	101,800	307,650,000	120,800,000	74,750	6,280
Stone and clay and their products	1,776	54,000	227,000,000	289,000,000	71,000	4,910
Textiles	17,830	641,500	3,495,800,000	384,000,000	208,500	37,500
Vehicles for land transportation	952	41,050	325,300,000	61,300,000	57,400	9,630
*Miscellaneous	7,516	265,741	1,392,800,000	444,313,000	334,000	40,400
Total for all industries in Middle Atlantic States	160,100	2,550,126	14,948,464,421	5,709,696,000	2,604,250	360,560

*Includes all domestic heating, small commercial power, irrigation and other pumping load. ** Includes only manufacturing establishments which reported products over $5,000 in value. † As of January 1, 1920. ‡ For year 1919.

Table V—Distribution of the 1923 Central-Station Power Load in the South Atlantic States

Industry	Total Number of Establishments (Including Those Using Central-Station Energy) Jan. 1, 1922 **	Average Number of Wage Earners 1921 **	Total Value of Products Manufactured 1921 **	Electrical Energy Sold by Central Station Companies During 1923, Kw.-Hr.	Estimated Sum of Central-Station Customers' Maximum Power Demands During 1923, Kw.	Estimated Number of Motors in Manufacturing Plants and Mines and in Buildings (Elevators, etc.) Using Central-Station Energy
Agricultural implements	220	1,360	$6,090,000	840,000	2,340	260
Chemicals and allied products (total)	1,357	42,669	344,400,000	767,570,000	132,700	11,490
Rubber and rubber products	20	2,190	19,200,000	1,715,000	870	50
Glass and glass products	233	12,950	58,450,000	29,950,000	16,450	2,030
Chemicals	370	6,133	53,400,000	33,000,000	29,500	2,940
Smelting and refining of metals	7	753	15,100,000	20,880,000	5,950	150
Artificial-gas manufacture	141	2,313	23,900,000	4,025,000	1,230	100
Miscellaneous chemical industries	586	18,330	174,350,000	678,000,000	98,700	6,220
Electrical equipment and machinery	28	821	3,300,000	3,750,000	1,670	320
Food and kindred products	3,000	37,600	360,000,000	211,200,000	111,300	15,970
Iron and steel and their products	750	55,000	235,800,000	208,000,000	109,500	12,650
Leather and its products	192	10,120	66,700,000	22,960,000	17,950	3,020
Lumber and its products	4,020	123,400	331,300,000	121,300,000	36,770	7,100
Metals and metal products other than iron or steel	245	3,280	28,000,000	141,250,000	54,700	9,400
Mining (total)	†30,286	†126,307	‡345,846,949	372,023,000	329,760	12,550
Coal	†1,515	†104,820	‡227,024,518	340,500,000	302,500	11,600
Petroleum and natural gas	†28,508	†12,302	‡99,518,304	4,110,000	2,040	120
Iron ore	†38	†1,015	‡1,703,143	.....	.....	.....
Gypsum	†2	†154	‡464,408	1,503,000	950	20
Phosphate rock	†42	†2,549	‡6,884,930	3,810,000	3,340	100
Stone quarries	†181	†5,467	‡10,251,646	22,550,000	20,930	710
Paper	47	6,440	46,100,000	131,700,000	32,180	4,470
Printing	1,790	22,740	126,700,000	20,040,000	19,800	13,740
Railroad-shop construction and repairs	223	41,800	39,770,000	165,700,000	78,200	6,390
Stone and clay and their products	817	16,230	52,550,000	93,900,000	36,200	2,500
Textiles	1,630	214,900	753,500,000	532,500,000	467,700	84,300
Vehicles for land transportation	197	3,860	33,555,000	9,580,000	8,980	1,520
*Miscellaneous	1,707	66,529	392,500,000	594,142,000	379,300	46,320
Total for all industries in South Atlantic States	46,509	773,056	3,166,111,949	3,395,555,000	1,839,050	232,000

* Includes all domestic heating, small commercial power and irrigation and pumping load. ** Includes only manufacturing establishments which reported products over $5,000 in value. † As of January 1, 1920. ‡ For year 1919.

or 14.4 per cent, for railways, and 23,930,458,000 kw.-hr., or 58.1 per cent, for power purposes. The proper balancing of these three loads is the problem of every central-station generating and distributing company.

Lighting Furnishes 62.4 per Cent of Gross Revenue Customers

The lighting load, while less than half of the power load, is the real revenue-producing load of the central-station industry. In 1923 approximately 62.4 per cent of the gross revenue received from light and power customers, not including electric railways, was from lighting customers, although, as indicated above, only 27.5 per cent of the total energy sold was consumed for lighting purposes. The number of lighting customers is twenty-six times that of the number of power customers, and the cost of distributing the lighting load is very much greater per kilowatt-hour sold than the cost of delivering the bulk energy to the industrial customer, all of which accounts for the greater revenue from less energy sold.

The amount of energy sold by central stations to electric railways is very much larger than generally thought. In 1923 it was a little over one-half the lighting consumption and 14.4 per cent of the total consumption. In the East North Central States the electric railway consumption of central-station energy is 77.3 per cent of that consumed for lighting purposes

Table VI—Distribution of the 1923 Central-Station Power Load in the East North Central States

Industry	Total Number of Establishments (Including Those Using Central-Station Energy) Jan. 1, 1922 **	Average Number of Wage Earners 1921 **	Total Value of Products Manufactured 1921 **	Electrical Energy Sold by Central-Station Companies During 1923, Kw.-Hr.	Estimated Sum of Central-Station Customers' Maximum Power Demands During 1923, Kw.	Estimated Number of Motors in Manufacturing Plants and Mines and in Buildings (Elevators, etc.) Using Central-Station Energy
Agricultural implements	1,120	52,150	$237,100,000	48,400,000	31,200	3,340
Chemicals and allied products (total)	2,353	105,301	1,073,084,000	761,580,000	286,400	21,640
Rubber and rubber products	217	31,860	318,000,000	290,500,000	114,700	7,110
Glass and glass products	233	20,100	60,034,000	35,220,000	19,230	2,380
Chemicals	1,155	21,550	245,150,000	78,400,000	57,240	5,700
Smelting and refining of metals	24	2,093	32,250,000	68,700,000	19,600	510
Artificial-gas manufacture	291	8,358	76,650,000	17,960,000	5,830	430
Miscellaneous chemical industries	433	21,340	341,000,000	270,800,000	69,800	5,510
Electrical equipment and machinery	470	64,006	337,365,000	162,200,000	69,900	15,580
Food and kindred products	10,700	157,250	2,088,400,000	296,800,000	180,800	25,880
Iron and steel and their products	4,220	288,000	1,911,000,000	1,208,000,000	527,600	61,000
Leather and its products	744	49,200	271,000,000	40,800,000	27,060	4,760
Lumber and its products	2,790	72,100	370,300,000	98,800,000	69,100	10,870
Metals and metal products other than iron or steel	2,390	50,300	410,500,000	349,000,000	232,000	40,470
Mining (total)	†59,149	†188,190	‡474,003,783	383,865,000	246,300	8,500
Coal	†1,728	†140,365	‡266,111,037	176,300,000	129,000	4,920
Copper	†28	†12,235	‡34,476,336	80,400,000	25,300	730
Petroleum and natural gas	†56,919	†8,279	‡79,365,860	675,000	340	20
Gypsum	†6	†466	‡1,393,224	2,620,000	1,910	50
Lead and zinc	†40	†1,317	‡4,438,207	4,750,000	1,490	40
Iron ore	†108	†17,305	‡64,733,564	65,900,000	48,100	1,390
Stone quarries	†320	†8,223	‡23,485,555	53,220,000	40,240	1,350
Paper	225	29,910	245,000,000	91,800,000	25,200	3,500
Printing	5,720	94,050	626,000,000	77,500,000	62,500	45,500
Railroad-shop construction and repairs	625	111,000	509,750,000	146,800,000	82,400	6,750
Stone and clay and their products	2,112	56,200	231,460,000	465,000,000	82,000	5,680
Textiles	2,420	145,000	673,500,000	69,200,000	50,500	9,080
Vehicles for land transportation	1,228	204,900	1,789,800,000	560,000,000	502,000	84,180
*Miscellaneous	4,988	223,794	1,141,700,000	701,507,000	495,000	59,800
Total for all industries in East North Central States	101,254	1,891,351	12,389,962,783	5,461,252,000	2,970,040	404,530

*Includes all domestic heating, small commercial power, irrigation, and pumping load. ** Includes only manufacturing establishments which reported products over $5,000 in value. †As of January 1, 1920. ‡ For year 1919.

and more than one-third of the industrial consumption.

The bulk of energy sold by central stations is for industrial power purposes. This is the load which has made the central station one of the great economic factors of the nation—one of which the importance and influence is increasing every year. In 1923 a total of 23,930,458,000 kw.-hr. of central-station electrical energy was consumed for power purposes. In addition to this, it is estimated that approximately fifteen billion kilowatt-hours of energy generated in private plants was also consumed for power purposes. The three intensely industrial Middle Atlantic States consumed 3,345,000,000 kw.-hr. of central-station energy for power purposes, followed by the East North Central States with 2,615,000,000 kw.-hr., these figures being for the year 1923. In every section of the country, however, the amount of energy consumed for power purposes is from one and one-half to four and one-half times that consumed for lighting.

The accompanying tables give the distribution of the central-station load among the primary industries in each of the nine sections of the country. These data are based upon a careful study of distribution reports submitted by a large number of the electric light and power companies of the country, and while not advanced as absolutely accurate, yet are believed to depict very closely the present segregation of the central-station load. Every statistical source of authority has been drawn upon to arrive at as correct a picture as possible of central-station industrial activity.

Lack of space prohibits a detailed discussion and interpretation of the various items for each section of the country. Within the tables, however, will be found much food for thought and detailed analysis by those interested in central-station operations in some specific section of the country. One or two outstanding points are, however, of special interest to the industry at large.

The two leading industries in the consumption of central-station energy are the iron and steel industry and the miscellaneous chemicals industry. In 1923 the iron and steel industry consumed more than three billion kilowatt-hours of energy and the miscellaneous chemicals industry consumed over two and a half billion kilowatt-hours. Under the term "iron and steel industry" are included all its branches—the great steel

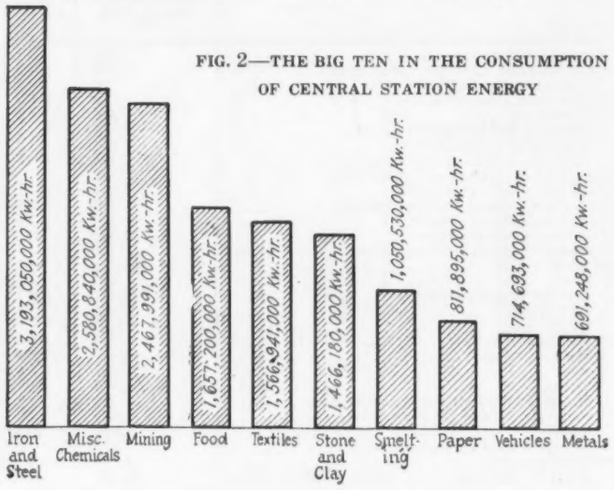


FIG. 2—THE BIG TEN IN THE CONSUMPTION OF CENTRAL STATION ENERGY

plants which manufacture pig iron and steel from the ore to the plants which manufacture all kinds of iron and steel products. Under "miscellaneous chemicals industry" is included, among others, that great branch known as the "electrochemical industry." Both of these groups of industries are extensive users of electrical energy for heating and electrochemical purposes in addition to the universal use of energy for the propulsion of motors. What proportion of the great amount of energy consumed by these two industries is used for heating and in electrochemical processes is not known, but it is undoubtedly very large, especially in the miscellaneous chemicals industry. And yet, notwithstanding the immense consumption of central-station energy at present, both of these industries offer extensive fields

Table VII—Distribution of the 1923 Central-Station Power Load in the West North Central States

Industry	Total Number of Establishments (Including Those Using Central-Station Energy) Jan. 1, 1922 **	Average Number of Wage Earners 1921 **	Total Value of Products Manufactured 1921 **	Electrical Energy, Sold by Central Station Companies to Various Industries During 1923, Kw.-Hr.	Estimated Sum of Central-Station Customers' Maximum Power Demands During 1923, Kw.	Estimated Number of Motors in Manufacturing Plants and Mines in Buildings (Elevators, etc.) Using Central-Station Energy
Agricultural implements	334	3,115	$15,890,000	5,960,000	3,820	410
Chemicals and allied products (total)	964	22,465	274,990,000	223,510,000	73,520	5,070
Rubber and rubber products	39	3,227	26,870,000	26,350,000	10,370	640
Glass and glass products	21	2,843	5,100,000	6,400,000	3,480	430
Chemicals	487	5,400	62,300,000	18,500,000	13,400	1,350
Smelting and refining of metals	8	880	22,250,000	66,000,000	18,700	490
Artificial-gas manufacture	192	2,625	29,670,000	8,260,000	2,420	180
Miscellaneous chemical industries	217	7,490	128,800,000	98,000,000	25,150	1,980
Electrical equipment and machinery	77	4,555	21,182,000	14,220,000	6,090	1,360
Food and kindred products	5,360	97,000	1,836,000,000	352,000,000	215,200	30,900
Iron and steel and their products	500	15,800	72,600,000	62,150,000	35,750	4,130
Leather and its products	323	23,220	138,000,000	25,750,000	16,970	2,980
Lumber and its products	1,257	36,600	138,700,000	32,950,000	22,950	3,810
Metals and metal products other than iron or steel	295	3,480	40,100,000	4,220,000	1,390	240
Mining (total)	†14,775	†60,461	‡277,279,356	213,660,000	119,960	3,940
Coal	†641	†26,735	‡46,686,934	39,320,000	28,500	1,090
Copper	†3	†182	‡388,310	5,470,000	1,710	50
Petroleum and natural gas	†13,628	†6,306	‡68,529,535	10,200,000	5,050	290
Gold and silver, lode mines	†6	†723	‡2,008,153			
Gypsum	†10	†574	‡1,583,085	2,420,000	1,760	50
Lead and zinc	†138	†6,541	‡22,885,619	74,800,000	23,370	670
Iron ore	†151	†16,424	‡128,681,122	61,650,000	44,720	1,290
Stone quarries	†198	†2,976	‡6,516,598	19,800,000	14,850	500
Paper	17	2,390	21,987,000	24,800,000	6,730	940
Printing	3,365	37,000	205,300,000	46,700,000	37,400	26,000
Railroad-shop construction and repairs	335	53,500	141,700,000	65,900,000	36,720	3,010
Stone and clay and their products	840	19,400	85,800,000	209,000,000	55,250	3,820
Textiles	567	30,200	119,000,000	5,220,000	3,780	680
Vehicles for land transportation	302	7,515	118,650,000	28,060,000	21,200	3,580
*Miscellaneous	1,583	1,720	310,100,000	283,599,000	204,100	24,700
Total for all industries in West North Central States	30,894	418,421	3,817,278,356	1,597,699,000	860,830	115,570

*Includes all domestic heating, small commercial power, irrigation, and other pumping load. **Includes only manufacturing establishments which reported prod

Table VIII—Distribution of the 1923 Central-Statio n Power Load in the East South Central States

Industry	Total Number of Establishments (Including Those Using Central-Station Energy) Jan. 1, 1922 **	Average Number of Wage Earners 1921 **	Total Value of Products Manufactured 1921 **	Electrical Energy Sold by Central-Station Companies During 1923, Kw.-Hr.	Estimated Sum of Central-Station Customers' Maximum Power Demands During 1923, Kw.	Estimated Number of Motors in Manufacturing Plants and Mines and in Buildings (Elevators, etc.) Using Central-Station Energy
Agricultural implements	88	1,783	$3,917,000	2,740,000	1,770	190
Chemicals and allied products (total)	410	7,452	95,370,000	104,698,000	38,710	2,980
Glass and glass products	3	132	730,000	208,000	110	10
Chemicals	182	2,717	22,380,000	7,390,000	5,400	540
Smelting and refining of metals	3	392	12,150,000	12,370,000	3,540	90
Artificial-gas manufacture	54	543	5,960,000	3,490,000	1,060	80
Miscellaneous chemical industries	168	3,668	54,150,000	81,240,000	28,600	2,260
Electrical equipment and machinery	14	505	2,051,000	779,000	340	80
Food and kindred products	1,430	15,878	149,007,000	63,650,000	18,420	2,640
Iron and steel and their products	580	32,000	203,500,000	117,700,000	66,800	7,730
Leather and its products	85	3,260	17,524,000	3,940,000	2,610	440
Lumber and its products	2,545	93,400	239,000,000	18,100,000	12,670	2,100
Metals and metal products other than iron or steel	81	750	10,600,000	3,270,000	1,050	180
Mining (total)	†7,054	†87,176	‡176,233,365	175,546,000	77,850	2,780
Coal	†1,129	†72,505	‡130,084,550	137,300,000	59,500	2,260
Copper	†3	†182	‡388,310	1,568,000	1,140	30
Petroleum and natural gas	†5,710	†2,120	‡23,343,898	.....	.....	.....
Phosphate rock	†24	†1,786	‡3,345,713	1,118,000	820	20
Lead and zinc	†2	†684	‡1,513,166	3,950,000	2,880	90
Iron ore	†72	†7,309	‡13,120,878	23,830,000	8,450	240
Stone quarries	†114	†2,590	‡4,436,850	7,780,000	5,060	140
Paper	4	572	3,880,000	4,845,000	1,180	160
Printing	781	9,825	52,150,000	8,460,000	6,830	4,750
Railroad-shop construction and repairs	108	29,000	19,900,000	22,280,000	12,500	1,020
Stone and clay and their products	457	9,740	30,600,000	48,300,000	10,160	700
Textiles	367	47,300	143,900,000	148,000,000	46,600	8,380
Vehicles for land transportation	126	3,718	24,050,000	7,385,000	5,640	940
*Miscellaneous	628	21,075	140,900,000	78,035,000	54,850	6,630
Total for all industries in East South Central States	14,758	363,434	1,312,582,365	807,728,000	357,980	41,700

*Includes all domestic heating, small commercial power, irrigation and other pumping load. **Includes only manufacturing establishments which reported products over $5,000 in value. †As of January 1, 1920. ‡For year 1919.

for central-station growth. In both industries are to be found a large development of the private generating plant, an attractive field for the central station, and in both will be found new processes of manufacture which will call for greater and greater amounts of energy. Probably, with the exception of the smelting and refining industry, no two industries of the country are more pregnant with possibilities for future central-station industrial load growth.

One of the chief problems of central-station distribution is that of efficient load building. The ideal load, other factors being equal, is, of course, one which is constant throughout twenty-four hours of the day. The nearer the distribution engineer can come to this ideal, the greater is the operating efficiency of his company. Each company is giving careful study to the diversified loads of its territory, paying special attention to those loads which will tend to level its load curve. The comparison of the kilowatt-hour consumption and the power demands of the various industries itemized in the accompanying tables will give a general idea of the load possibilities for the country as a whole. In the end the crux of central-station operation is the revenue which is received from the consumer, and revenue is dependent absolutely on the number of kilowatt-hours sold. Industries such as the electrochemical, the operations of which extend over the entire twenty-four hours of the day, are large users of energy without disproportionately increasing the demand on the generating plant. The smelting and the iron and steel industries

Table IX—Distribution of the 1923 Central-Station Power Load in the West South Central States

Industry	Total Number of Establishments (Including Those Using Central-Station Energy) Jan. 1, 1922 **	Average Number of Wage Earners 1921 **	Total Value of Products Manufactured 1921 **	Electrical Energy, Sold by Central-Station Companies During 1923, Kw.-Hr.	Estimated Sum of Central-Station Customers' Maximum Power Demands During 1923, Kw.	Estimated Number of Motors in Manufacturing Plants and Mines and in Buildings (Elevators, etc.) Using Central-Station Energy
Chemicals and allied products (total)	555	23,271	$620,517,000	257,894,000	74,090	3,466
Rubber and rubber products	15	693	6,270,000	242,000	100	6
Glass and glass products	65	2,285	12,180,000	1,627,000	890	110
Chemicals	154	1,298	12,467,000	5,210,000	3,800	380
Smelting and refining of metals	17	2,552	79,000,000	163,800,000	46,650	1,190
Artificial-gas manufacture	36	783	5,100,000	4,715,000	1,450	110
Miscellaneous chemical industries	268	15,660	505,500,000	82,300,000	21,200	1,670
Electrical equipment and machinery	9	138	680,000	157,000	70	10
Food and kindred products	11,100	30,000	386,000,000	81,100,000	49,400	7,100
Iron and steel and their products	59	2,370	8,930,000	5,480,000	3,160	370
Leather and its products	78	1,105	6,140,000	1,205,000	800	130
Lumber and its products	1,719	116,400	328,600,000	17,220,000	12,050	2,000
Metals and metal products other than iron or steel	82	590	9,523,000	,696,000	220	40
Mining (total)	†60,087	†59,535	‡472,177,815	104,760,000	43,350	1,550
Coal	†264	†12,538	‡24,091,691	18,580,000	13,550	520
Petroleum and natural gas	†59,610	†39,636	‡423,472,731	14,820,000	4,670	270
Lead and zinc	†134	†5,281	‡18,994,321	62,850,000	19,800	560
Stone quarries	†65	†1,144	‡2,826,655	4,430,000	3,360	150
Gold and silver, lode mines	†6	†723	‡2,008,153	3,030,000	1,260	30
Gypsum	†8	†213	‡784,264	1,050,000	710	20
Paper	8	1,000	6,800,000	9,170,000	2,510	340
Printing	1,397	13,330	73,570,000	11,000,000	8,870	6,150
Railroad-shop construction and repairs	186	23,500	24,870,000	27,270,000	15,300	1,250
Stone and clay and their products	360	6,175	23,570,000	49,400,000	13,200	910
Textiles	116	9,346	28,760,000	11,140,000	8,130	1,470
Vehicles for land transportation	112	2,782	44,100,000	3,085,000	2,360	390
*Miscellaneous	7	3,159	126,050,000	50,246,000	35,350	4,280
Total for West South Central States	75,875	292,701	2,160,287,815	629,823,000	268,860	29,456

*Includes all domestic heating, small commercial power, irrigation and other pumping load. **Includes only manufacturing establishments which reported products over $5,000 in value. †As of January 1, 1920. ‡For year 1919.

Table X—Distribution of the 1923 Central-Station Power Load in the Mountain States

Industry	Total Number of Establishments (Including Those Using Central-Station Energy) Jan. 1, 1922 **	Average Number of Wage Earners 1921 **	Total Value of Products Manufactured 1921 **	Electrical Energy, Sold by Central Station Companies During 1923, Kw.-Hr.	Estimated Sum of Central-Station Customers' Maximum Power Demands During 1923, Kw.	Estimated Number of Motors in Manufacturing Plants and Mines and in Buildings (Elevators, etc.) Usin Central-Station Energy
Agricultural implements	7	125	$203,000	61,000	40	4
Chemicals and allied products (total)	207	10,023	237,750,000	588,250,000	168,640	4,990
Rubber and rubber products	5	660	3,330,000	2,685,000	1,060	60
Chemicals	55	600	6,620,000	5,475,000	4,080	490
Smelting and refining of metals	34	3,408	120,350,000	557,700,000	157,600	4,030
Artificial-gas manufacture	54	925	7,050,000	2,310,000	660	20
Miscellaneous chemical industries	59	4,430	100,400,000	20,080,000	5,240	390
Electrical equipment and machinery	8	78	397,000	142,000	60	5
Food and kindred products	1,330	20,980	266,300,000	53,750,000	34,500	7,790
Iron and steel and their products	29	1,460	7,925,000	6,220,000	3,600	460
Leather and its products	56	636	3,131,000	580,000	390	30
Lumber and its products	512	17,919	61,063,000	11,500,000	6,850	1,140
Metals and metal products other than iron or steel	82	490	10,600,000	122,000	80	10
Mining (total)	†2,858	†73,642	‡296,022,715	495,878,000	231,700	7,183
Coal	†374	†29,377	‡78,218,698	90,500,000	61,250	2,250
Petroleum and natural gas	†1,393	†2,285	‡22,371,577	224,000	110	6
Lead and zinc	†123	†5,289	‡20,813,610	64,700,000	36,870	1,060
Iron ore	†14	†448	‡1,136,362	315,000	230	7
Stone quarries	†86	†1,256	‡3,163,228	5,030,000	3,820	130
Gold and silver, lode mines	†661	†10,237	‡43,582,488	100,700,000	57,300	1,650
Gypsum	†14	†336	‡1,274,429	1,807,000	1,310	40
Copper	†153	†24,150	‡124,309,018	227,800,000	67,300	1,940
Gold, placer mines	†37	†227	‡1,083,750	4,385,000	3,200	90
Phosphate rock	†3	†37	‡69,555	417,000	310	10
Printing	798	7,075	38,300,000	8,300,000	5,120	3,560
Railroad-shop construction and repairs	140	18,325	188,900,000	18,570,000	12,630	1,040
Stone and clay and their products	272	3,940	18,530,000	56,480,000	22,400	1,550
Textiles	47	1,300	5,468,000	651,000	480	80
Vehicles for land transportation	47	930	14,470,000	5,123,000	3,910	650
*Miscellaneous	302	69	244,000	268,176,000	210,000	25,850
Total for Mountain States	6,695	156,992	1,149,303,715	1,513,803,000	700,400	54,342

* Includes all domestic heating, small commercial power, irrigation and other pumping load. **Includes only manufacturing establishments which reported products over $5,000 in value. † As of January 1, 1920. ‡ For year 1919.

are also industries of this type, but the iron and steel industry, when considered nationally, embraces so many branches in which large motors operated intermittently are included that the kilowatt-hour consumption per kilowatt demand is low. Taken in the districts of large steel plants, this type of consumer is, of course, much to be desired.

On account of the utter lack of statistics for the past years, it is almost impossible to look into the future and foretell central-station distribution. A more extended study of past census data as they relate to the horsepower of motors in industrial plants run by central-station energy and a study of the present electrical saturation of the various industries may give a basis for looking into the future. Data such as are given in the accompanying tables, however, are not available for past years with the exception of 1920, for which the ELECTRICAL WORLD presented data in the issue of January 6, 1923. The industry will expand materially, of course, during the next few years, and the load distribution of 1930 will undoubtedly be relatively different from that of 1923.

Table XI—Distribution of the 1923 Central-Station Power Load in the Pacific States

Industry	Total Number of Establishments (Including Those Using Central Station Energy) Jan. 1, 1922 **	Average Number of Wage Earners 1921 **	Total Value of Products Manufactured 1921 **	Electrical Energy, Sold by Central Station Companies During 1923, Kw.-Hr.	Estimated Sum of Central-Station Customers' Maximum Power Demands During 1923, Kw.	Estimated Number of Motors in Manufacturing Plants, Mines, on Farms and in Buildings (Elevators, etc.) Using Central-Station Energy
Agricultural implements	250	2,430	$10,745,000	8,730,000	5,630	600
Chemicals and allied products (total)	638	13,760	338,100,000	368,575,000	120,710	8,630
Rubber and rubber products	31	1,445	13,150,000	9,900,000	3,880	230
Glass and glass products	26	1,163	5,850,000	6,525,000	3,570	440
Chemicals	322	2,432	28,300,000	34,250,000	25,600	2,550
Smelting and refining of metals	4	588	18,250,000	98,200,000	27,730	720
Artificial-gas manufacture	106	2,182	20,550,000	103,400,000	29,630	2,200
Miscellaneous chemical industries	149	5,950	252,000,000	116,300,000	30,300	2,490
Electrical equipment and machinery	92	1,874	10,912,000	12,540,000	5,420	1,210
Food and kindred products	3,033	57,350	739,080,000	346,000,000	222,000	31,900
Iron and steel and their products	405	50,500	209,300,000	131,800,000	76,300	8,830
Leather and its products	199	3,445	20,470,000	13,220,000	8,740	1,540
Lumber and its products	2,180	122,600	529,350,000	200,300,000	119,200	19,180
Metals and metal products other than iron or steel	375	3,120	28,200,000	2,590,000	1,670	290
Mining (total)	†9,804	†30,514	‡196,216,750	383,712,000	199,650	7,782
Coal	†47	†4,466	‡10,786,186	33,200,000	22,450	860
Petroleum and natural gas	†9,378	†12,344	‡139,018,663	120,700,000	60,300	3,480
Lead and zinc	†30	†723	‡2,394,928	14,150,000	6,130	180
Iron Ore	†2	†80	‡206,610	44,000	30	1
Stone quarries	†87	†1,158	‡2,788,146	20,370,000	15,420	520
Gold and silver, lode mines	†126	†3,753	‡11,233,536	71,400,000	40,400	1,160
Gypsum	†2	†50	‡196,066	648,000	470	11
Copper	†37	†6,787	‡21,307,804	74,600,000	19,000	550
Gold, placer mines	†95	†1,153	‡8,284,811	48,600,000	35,450	1,020
Paper	20	2,900	22,340,000	26,580,000	6,130	850
Printing	2,015	23,660	153,620,000	40,200,000	24,800	17,220
Railroad-shop construction and repairs	139	23,800	24,863,000	62,100,000	42,250	3,460
Stone and clay and their products	374	9,575	59,400,000	237,000,000	93,300	6,450
Textiles	590	17,830	76,000,000	17,230,000	12,580	2,260
Vehicles for land transportation	348	6,115	75,800,000	24,480,000	18,100	3,130
Farm power, irrigation pumping, etc.				520,000,000	427,000	58,800
*Miscellaneous	1,478	1,239	234,000,000	799,749,000	555,500	67,050
Total for Pacific States	21,940	370,712	2,728,396,750	3,194,806,000	1,938,980	239,182

* Includes all domestic heating, small commercial power and pumping load, except irrigation. ** Includes only manufacturing establishments which reported products over $5,000 in value † As of January 1, 1920. ‡ For year 1919.

A Prominent Central-Station Executive Emphasizes the Importance of

Understanding the Public

By M. S. Sloan
President Brooklyn Edison Company

SINCE the electric utilities have been giving an unfortunately belated attention to the creation of sound, friendly relations with the public we have all heard a great deal about the necessity of fostering an understanding of our industry by the public. That is vastly important to the success of our endeavor. I believe it is even more important that there be fostered within our industry an understanding of the public.

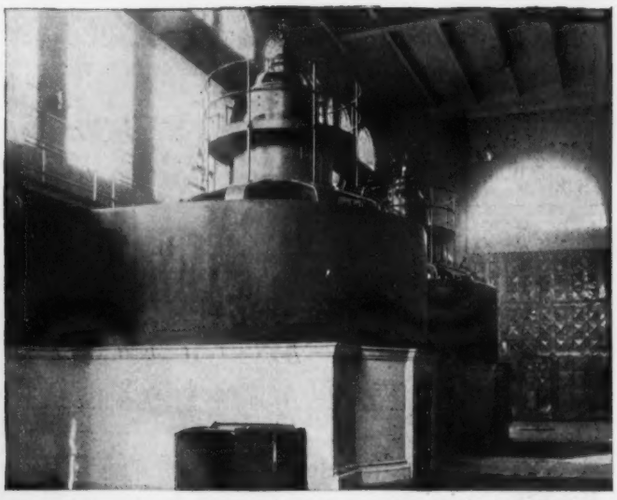
Until we of the electrical industry understand better than we now do this great body of individuals which we too often lump together in the term "the public" we are likely to muddle our attempts to win understanding for our industry. Understanding must be reciprocal if it is to get anywhere. We are more concerned with the establishment of this reciprocal understanding than the general public is. It behooves us of the industry, particularly chief executives and boards of directors—the people who are directly charged with the duty of formulating policies for the companies they represent—to get down to rock bottom, to study and solve this problem just as all the technical and financial problems which have beset us have been solved.

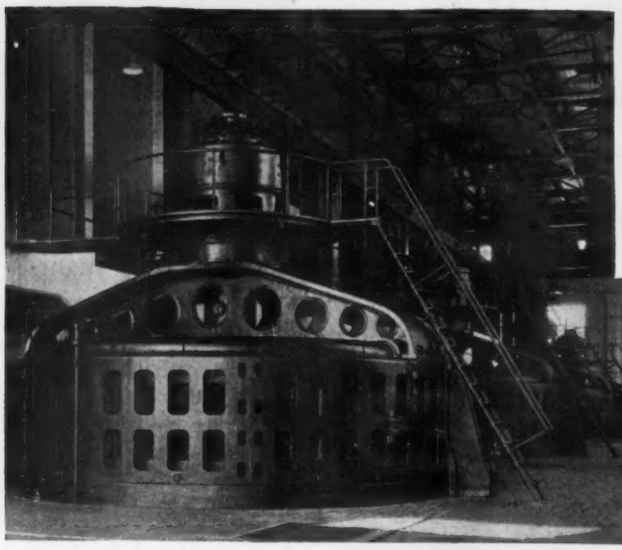
It has been my experience that the utilities think too much of "the public" and too little of the human beings who compose the public. Psychologists tell us that there is such a thing as "mass psychology" which differs from the psychology of the individual; but I believe the lack of understanding, the indifference, the antagonism which confront the utilities are not a manifestation of mass spirit. I believe they are merely the sum total of the feeling of the individual human beings toward the utilities. I believe, further, that to break down this feeling we of the utilities must convince individuals—naturally, individuals in very large numbers—that we also are human and are endeavoring honestly and sincerely to live and do business on a basis in which human obligations have an important part.

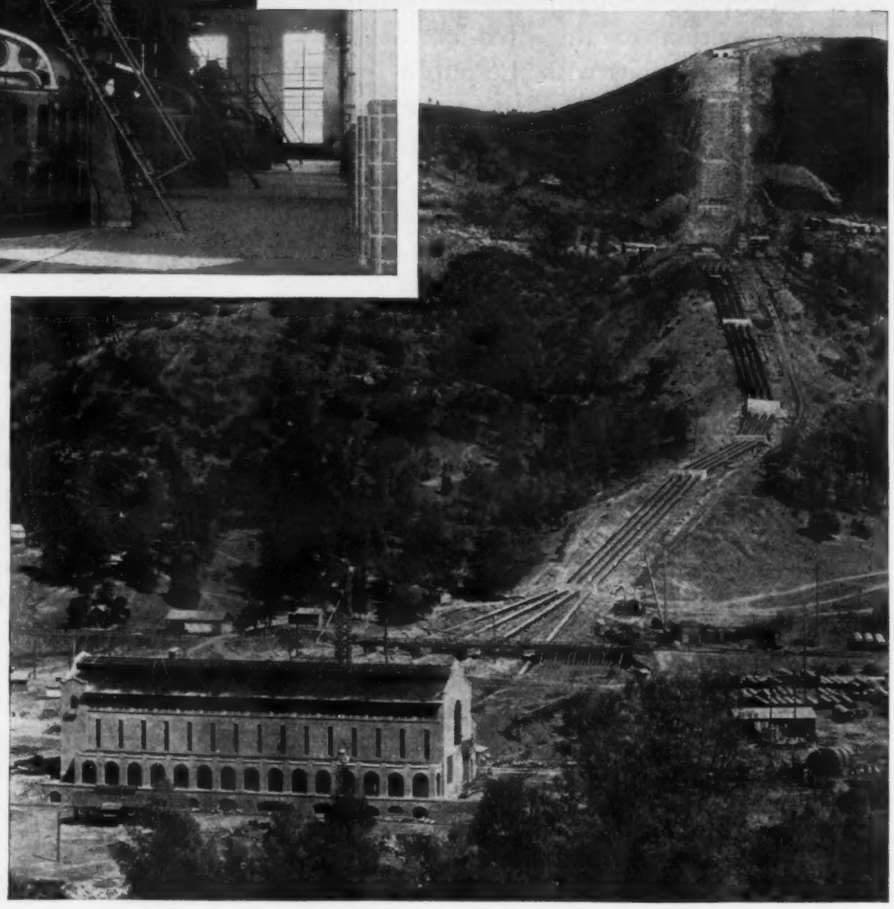
That is the keynote of my platform for sound public relations for the industry and for the companies which compose it. The first move toward this establishment of reciprocal understanding and accompanying friendship must always be ours. The methods and technique employed must depend on the company and its circumstances, but, if it's necessary to prove we're human, let's prove it! Let us do whatever is necessary to prove it. Let us get away from the red-tape and brass-grill-in-front-of-the-desk methods. Let us put the emphasis on "Public Service" rather than on the "Corporation" in our designation. Let us pay more attention to the spirit of the transaction than the letter. Let us consider more the earning of public approval than the earning of dollars. If we earn that approval, the dividends will be earned none the less surely.

This isn't altruism. It's plain business sense—though that in itself may resemble altruism more frequently than we suspect.

Progress in Hydro-Electric Development

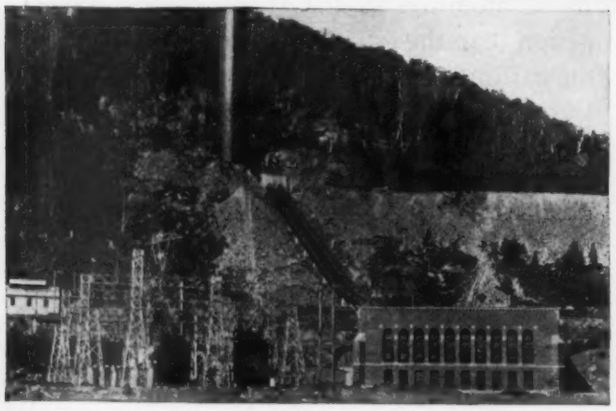


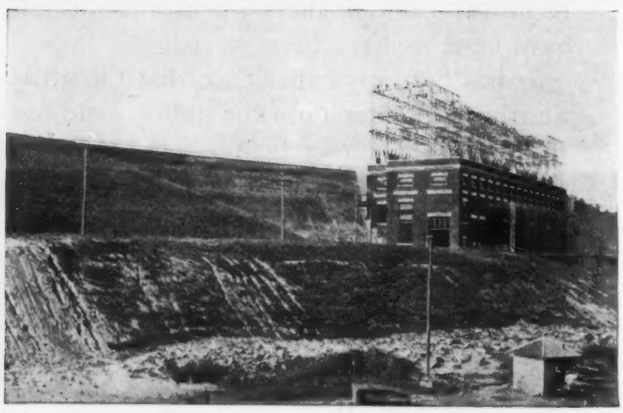




WITH the possible exception of the continued work at Muscle Shoals and on the Pacific Coast and some important Canadian developments, there has been no outstanding development in the hydro-electric field during 1924. Most of the work has concerned small projects, many instances of which can be seen in almost any part of the country. Complete automatic generating stations have grown in favor, and in design the adoption of higher specific speeds for turbine runners has resulted in a reduction in size and cost of generating machinery and in the space occupied.

The two views at the top of the page show the interiors of the Mountain Island plant of the Southern Power Company and of the Davis Bridge project of the New England Power Company respectively. The two views at the bottom show the exterior of these plants, but in reverse order. The Moccasin Creek plant of the Hetch Hetchy project, having four 20,000-kva. units, is shown in the center.





SKYLINE OF NEW YORK CITY—A TRIUMPH IN ELECTRICAL ILLUMINATION

Potential Field of the Industry

More than 90 per Cent of the Population in Cities, Towns and Villages Are Now Served by Central Station Systems—Growth of the Industry Will Continue

STUDENTS of the industry are intensely interested in the future of the central station. There has, perhaps, never been a primary industry which has exhibited such a constantly accelerated growth as the electric light and power industry. True, industries have risen over night to great power and influence, but such advances have been the result of some temporary need or emergency. With the passing of the emergency, these industries have dwindled to small proportions or entirely disappeared. The growth of the electric light and power industry is, however, of an entirely different nature. Slow in its beginning, the central station has risen to its present high position by reason of the service it has rendered and is rendering to humanity and of the wise policies of public good will which it has constantly maintained.

In studying the future operations of an industry two basic principles must be kept in mind. First, the value of the industry to humanity—in the home, in industry in general and in civic life—and, second, the degree of saturation of its field which that industry has accomplished. The place of the electric light and power industry in the present economic life of America is unquestioned—it is now as essential to American life as the newspaper, if not more so. The question remains, therefore, of the present saturation and the probable new uses to which electrical energy will be put.

A Nation-Wide Viewpoint Essential

To those living in the metropolitan areas it would appear as if the central station had practically covered its field of operations and as if its future growth must depend very largely upon new construction for increased domestic consumption and upon growth in general industry for increased power consumption. This view, however, is distorted by the fact that the concentrated areas have naturally been the ones which the central station has developed to the greatest extent. When the nation is viewed as a whole or by state units, the fertile field which extends before the industry is made apparent. Such a national view of present and future central-station operations is to be gained from the accompanying tabulations showing the number and population of the cities, towns and villages in the United States served and not served at the present time by central-station systems. These data are based upon the "McGraw Central Station Directory" and the United States "Official Postal Guide" for 1924. Only such communities are included as are of enough importance to have a post office or city postal service. There are approximately 132,000 named communities in the country, but about eighty thousand of these are of no real importance, being for the most part merely crossroad communities with a few buildings and in no sense urban in character. The study shows that there are 53,287 cities, towns and villages in the country which have post offices or have city postal service. Of this number 16,642 are served by central-station lines and 36,645 are without electric service. There are no towns above 5,000 population not served by central stations. The tabulation shows sixty-two towns of a population between 2,501 and 5,000 not reached by central-station systems, but it is believed probable that some of these are served, having either not been so reported or being served as a part of an adjoining town without being specifically mentioned. There are only 4,104 villages with a population under 250 which are served, and 28,644 villages of this class do not have electric service. There are thousands of towns of less than 250 population which probably never will be served from central-station lines on account of their isolation. These towns must continue to use kerosene or acetylene

Number and Population of Cities, Towns and Villages in the United States Served and Not Served by Central-Station Systems

State and Section	Cities, Towns and Villages Reached and Served By Central-Station Lines Jan. 1, 1924		Towns and Villages *Not* Reached or Served By Central-Station Lines Jan. 1, 1924*		Percentage Distribution in the Country as Whole		Over 1,000,000 Population		500,001 to 1,000,000 Population		100,001 to 500,000 Population		50,001 to 100,000 Population		25,001 to 50,000 Population		10,001 to 25,000 Population		5,001 to 10,000 Population		2,501 to 5,000 Population			
	Total Number of Towns	Aggregate Population of All Towns Served	Total Number of Towns	Aggregate Population of All Towns *Not* Served	Per Cent of Urban Population in Towns Served†	Per Cent of Urban Population in Towns *Not* Served†	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns *Not* Served*	Aggregate Population of Towns *Not* Served*
United States	16,642	65,633,719	36,645	6,816,541	90.6	9.4	4	1,404,151	9	5,963,986	62	11,719,084	74	5,189,960	141	4,943,750	462	6,839,588	755	5,260,428	1,515	5,262,960	62	186,402
New England	1,413	7,449,263	1,656	654,163	92.0	8.0	0	0	1	748,060	10	1,466,800	11	843,032	26	942,709	77	1,168,462	111	788,931	182	605,557	15	47,842
Middle Atlantic	3,107	19,200,808	3,716	981,652	95.2	4.8	2	7,453,930	3	1,826,984	14	2,321,332	18	1,269,677	28	944,247	108	1,648,402	160	1,110,834	301	1,043,439	9	25,542
South Atlantic	1,316	4,987,127	8,071	1,302,281	79.4	20.6	0	0	1	733,826	5	1,035,799	8	509,749	17	565,881	35	502,072	63	409,079	146	493,331	13	43,091
East North Central	3,626	15,249,168	3,205	768,704	95.3	4.7	2	3,950,221	1	796,836	10	2,311,225	17	1,144,539	43	1,524,665	103	1,552,529	165	1,147,428	256	897,863	7	20,573
West North Central	3,393	6,573,355	4,399	617,422	91.3	8.7	0	0	1	772,897	6	1,411,679	7	501,771	5	187,480	47	706,305	78	560,973	175	625,201	1	4,550
East South Central	634	2,491,099	5,293	805,702	75.6	24.4	0	0	0	0	4	693,856	4	286,854	3	122,781	22	333,967	40	278,521	109	374,707	7	13,835
West South Central	1,052	3,660,064	4,862	995,477	78.7	21.3	0	0	0	0	6	1,102,521	3	233,801	7	260,672	34	395,136	59	434,120	166	599,685	7	19,977
Mountain	945	1,767,577	3,214	432,190	80.4	19.6	0	0	0	0	2	374,479	1	55,000	4	133,573	16	228,347	35	239,160	74	254,554	3	10,992
Pacific	1,156	4,255,258	2,229	258,950	94.3	5.7	0	0	2	1,085,383	5	1,001,393	5	345,537	8	261,742	20	304,368	44	291,382	106	368,623	0	0
New England																								
Maine	308	673,012	565	187,392	78.3	21.7	0	0	0	0	0	0	1	69,196	2	57,739	6	86,951	16	106,624	32	108,355	0	0
New Hampshire	193	440,304	220	64,447	87.3	12.7	0	0	0	0	0	0	1	78,200	1	28,379	7	97,469	5	34,797	19	59,089	0	0
Vermont	212	248,603	225	86,671	74.2	25.8	0	0	0	0	0	0	0	0	0	0	3	47,741	5	39,423	9	32,884	0	0
Massachusetts	411	4,006,663	430	204,960	95.3	4.7	0	0	1	748,060	6	785,112	6	477,410	15	592,990	36	559,962	53	372,708	73	242,036	12	38,416
Rhode Island	82	642,668	60	39,998	94.1	5.9	0	0	0	0	1	237,595	1	67,500	3	105,912	6	96,361	8	59,432	12	39,752	3	9,426
Connecticut	207	1,438,013	156	70,695	95.3	4.7	0	0	0	0	3	444,093	2	150,726	5	157,689	19	279,978	24	175,947	37	123,441	0	0
Middle Atlantic																								
New York	1,131	10,034,995	1,342	308,075	97.0	3.0	1	5,621,151	2	1,238,791	5	789,801	5	377,179	12	384,150	39	548,113	36	215,701	92	302,158	1	3,250
New Jersey	521	2,627,169	346	104,307	96.2	3.8	0	0	0	0	5	983,544	6	405,695	9	286,419	17	260,370	33	233,096	66	232,902	2	5,575
Pennsylvania	1,455	6,538,644	2,028	569,270	91.9	8.1	1	1,832,779	1	588,193	4	547,987	7	486,803	7	273,678	52	839,919	91	662,037	143	508,379	6	16,717
South Atlantic																								
Delaware	48	149,018	62	12,108	92.5	7.5	0	0	0	0	1	110,168	0	0	0	0	0	0	0	0	3	10,599	0	0
Maryland	150	943,696	638	107,459	89.8	10.2	0	0	1	733,826	0	0	0	0	2	57,866	2	22,280	3	23,484	7	22,495	2	7,585
Dist. of Columbia	1	437,571	0	0	100.0	0.0	0	0	0	0	1	437,571	0	0	0	0	0	0	0	0	0	0	0	0
Virginia	185	804,069	2,075	228,133	77.8	22.2	0	0	0	0	2	287,444	2	105,231	4	124,110	4	60,908	10	69,614	21	69,727	2	7,300
West Virginia	146	363,200	1,814	292,676	55.3	44.7	0	0	0	0	0	0	1	56,208	2	67,477	4	63,750	4	28,348	20	66,580	2	6,558
North Carolina	248	650,075	1,324	210,641	75.5	24.5	0	0	0	0	0	0	0	0	5	185,209	11	138,665	15	97,352	30	100,351	1	2,530
South Carolina	135	380,669	502	104,946	78.4	21.6	0	0	0	0	0	0	1	67,957	1	37,520	4	67,875	8	52,854	17	61,775	4	13,080
Georgia	216	870,684	923	211,469	80.5	19.5	0	0	0	0	1	200,616	3	188,795	1	33,150	7	101,857	14	95,626	33	109,895	2	6,038
Florida	187	388,145	733	134,849	74.2	25.8	0	0	0	0	0	0	1	91,558	2	60,549	3	46,737	9	41,801	15	51,909	0	0
East North Central																								
Ohio	754	3,982,412	975	249,007	94.0	6.0	0	0	1	796,836	6	1,374,794	2	147,931	12	406,303	26	402,298	40	285,813	53	190,639	3	8,782
Indiana	583	1,735,285	576	130,362	93.0	7.0	0	0	0	0	1	233,650	5	380,325	6	196,990	19	294,103	24	174,496	39	145,380	0	0
Illinois	1,082	5,191,588	706	150,128	97.2	2.8	1	2,886,121	0	0	0	0	4	267,695	12	433,250	27	406,212	46	317,409	83	278,276	0	0
Michigan	553	2,765,882	399	133,112	95.5	4.5	1	1,064,100	0	0	2	245,634	5	289,995	6	243,717	19	247,084	34	223,429	39	135,169	3	7,591
Wisconsin	654	1,574,001	549	106,095	93.8	6.2	0	0	0	0	1	457,147	1	58,593	7	244,405	12	202,832	21	146,281	42	148,399	1	4,200
West North Central																								
Minnesota	680	1,448,002	640	72,251	95.3	4.7	0	0	0	0	2	663,040	1	98,917	0	0	9	127,743	13	116,591	29	115,228	0	0
Iowa	867	1,137,446	412	85,845	93.0	7.0	0	0	0	0	0	0	2	136,727	3	117,958	11	194,126	19	119,419	42	145,651	1	4,550
Missouri	519	1,943,448	1,402	190,868	91.0	9.0	0	0	1	772,897	1	324,410	1	77,939	2	69,522	8	109,656	17	115,203	39	138,241	0	0
North Dakota	182	191,126	515	79,112	70.7	29.3	0	0	0	0	0	0	0	0	0	0	3	46,447	3	18,718	6	22,898	0	0
South Dakota	193	176,563	398	51,358	77.5	22.5	0	0	0	0	0	0	0	0	0	0	1	14,537	6	46,117	5	16,684	0	0
Nebraska	417	643,056	469	54,188	92.3	7.7	0	0	0	0	1	191,601	1	54,934	0	0	2	30,607	11	77,023	17	56,346	0	0
Kansas	535	1,033,714	563	83,800	92.5	7.5	0	0	0	0	2	232,628	2	133,254	0	0	13	183,189	9	67,902	37	130,153	0	0
East South Central																								
Kentucky	198	766,355	2,426	271,994	73.8	26.2	0	0	0	0	1	234,891	1	57,121	2	79,317	4	67,413	13	94,758	33	116,370	5	7,757
Tennessee	162	711,811	884	160,316	81.7	18.3	0	0	0	0	2	280,695	2	139,733	0	0	2	31,302	9	59,027	33	109,837	2	6,078
Alabama	156	677,974	1,117	221,313	75.4	24.6	0	0	0	0	1	178,270	1	90,000	1	43,464	7	99,293	10	67,385	27	95,115	0	0
Mississippi	118	334,959	866	152,079	68.8	31.2	0	0	0	0	0	0	0	0	0	0	9	135,959	8	57,351	16	53,385	0	0
West South Central																								
Arkansas	161	436,237	1,316	197,038	68.8	31.2	0	0	0	0	0	0	1	65,000	1	28,811	3	45,882	9	91,390	34	110,437	0	0
Louisiana	88	722,633	971	210,510	77.4	22.6	0	0	0	0	1	387,219	0	0	1	43,874	4	68,763	8	54,991	23	119,346	2	5,500
Oklahoma	282	580,740	809	168,041	77.5	22.5	0	0	0	0	1	102,018	1	91,258	1	30,277	9	15,387	16	112,993	37	121,742	3	8,439
Texas	521	1,920,454	1,766	419,888	82.0	18.0	0	0	0	0	4	613,284	1	77,543	4	157,710	18	265,104	26	174,746	72	248,160	2	6,038
Mountain																								
Montana	130	240,742	758	68,705	77.8	22.2	0	0	0	0	0	0	0	0	1	41,611	5	75,594	6	37,136	6	20,409	0	0
Idaho	189	213,338	342	44,535	82.7	17.3	0	0	0	0	0	0	0	0	0	0	2	36,394	7	47,570	12	38,341	0	0
Wyoming	60	98,481	347	38,289	72.0	28.0	0	0	0	0	0	0	0	0	0	0	2	25,276	3	24,630	4	13,140	0	0
Colorado	196	574,644	630	77,640	88.0	12.0	0	0	0	0	1	256,369	1	55,000	1	30,105	3	33,315	6	42,048	18	61,673	0	0
New Mexico	41	93,914	535	96,514	49.3	51.7	0	0	0	0	0	0	0	0	0	0	1	15,157	4	24,892	8	31,470	2	7,917
Arizona	55	162,958	244	39,046	80.7	19.3	0	0	0	0	0	0	0	0	1	29,053	1	20,292	7	48,163	11	37,731	1	3,075
Utah	230	334,220	208	47,833	87.5	12.5	0	0	0	0	1	118,110	0	0	1	32,804	1	10,303	2	14,721	12	39,570	0	0
Nevada	44	49,271	150	19,628	71.5	28.5	0	0	0	0	0	0	0	0	0	0	1	12,016	0	0	3	12,220	0	0
Pacific																								
Washington	247	897,650	692	91,748	90.8	9.2	0	0	0	0	2	420,079	1	98,000	2	54,644	5	68,074	7	48,962	23	75,710	0	0
Oregon	212	485,415	570	42,034	92.1	7.9	0	0	0	0	0	0	0	0	0	0	1	21,206	2	14,259	15	23,146	0	0
California	697	2,872,193	967	125,168	95.8	4.2	0	0	2	1,085,383	2	323,020	4	247,537	6	207,098	13	204,308	30	127,259	25	232,146	0	0

Number and Population of Cities, Towns and Villages in the United States Served and Not Served by Central-Station Systems (Continued)

State and Section	1,001 to 2,500 Population		501 to 1,000 Population		251 to 500 Population		Under 250 Population		
	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns Served	Aggregate Population of Towns Served	Aggregate Population of Towns *Not* Served*
United States	2,000	3,161,000	1,000	707,000	500	177,000	1,000	177,000	1,000,000
New England	200	316,000	100	71,000	50	18,000	100	18,000	100,000
Middle Atlantic	400	632,000	200	141,000	100	35,000	200	35,000	200,000
South Atlantic	200	316,000	100	71,000	50	18,000	100	18,000	100,000
East North Central	400	632,000	200	141,000	100	35,000	200	35,000	200,000
West North Central	200	316,000	100	71,000	50	18,000	100	18,000	100,000
East South Central	200	316,000	100	71,000	50	18,000	100	18,000	100,000
West South Central	200	316,000	100	71,000	50	18,000	100	18,000	100,000
Mountain	200	316,000	100	71,000	50	18,000	100	18,000	100,000
Pacific	200	316,000	100	71,000	50	18,000	100	18,000	100,000

Number and Population of Cities, Towns and Villages in the United States Served and Not Served by Central-Station Systems (Continued)

State and Section	1,001 to 2,500 Population						501 to 1,000 Population						251 to 500 Population						Under 250 Population					
	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns *Not* Served*	Aggregate Population of Towns *Not* Served*	Per Cent of Urban Population in Towns Served†	Per Cent of Urban Population in Towns *Not* Served†	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns *Not* Served*	Aggregate Population of Towns *Not* Served*	Per Cent of Urban Population in Towns Served†	Per Cent of Urban Population in Towns *Not* Served†	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns *Not* Served*	Aggregate Population of Towns *Not* Served*	Per Cent of Urban Population in Towns Served†	Per Cent of Urban Population in Towns *Not* Served†	Total Number of Towns Served	Aggregate Population of Towns Served	Total Number of Towns *Not* Served*	Aggregate Population of Towns *Not* Served*	Per Cent of Urban Population in Towns Served†	Per Cent of Urban Population in Towns *Not* Served†
United States	3,218	4,876,478	614	864,186	84.9	15.1	3,198	2,421,544	2,228	1,441,021	62.7	37.3	3,100	1,175,431	5,097	1,748,660	40.2	59.9	4,104	576,359	28,644	2,576,272	18.3	81.7
New England	389	598,705	114	164,014	78.5	21.5	243	193,454	268	180,404	51.7	48.3	168	64,386	393	141,757	31.2	68.8	195	29,167	866	120,146	19.6	80.4
Middle Atlantic	561	881,629	102	145,886	85.8	14.2	486	371,075	385	250,058	59.8	40.2	515	194,320	723	248,794	43.8	56.2	911	134,939	2,497	311,372	30.3	69.7
South Atlantic	290	438,137	131	177,514	71.3	28.7	242	183,773	372	242,713	43.2	56.8	180	68,501	927	316,123	17.8	82.2	329	46,979	6,628	522,840	8.2	91.8
East North Central	638	973,409	56	81,392	92.2	7.8	797	565,740	223	145,112	79.7	20.3	709	269,216	777	264,057	50.4	49.6	885	115,497	2,142	257,570	31.0	69.0
West North Central	496	782,706	16	20,277	97.4	2.6	653	541,848	134	88,001	85.8	14.2	935	347,720	491	165,967	67.7	32.3	990	134,775	3,757	328,627	28.4	71.6
East South Central	171	258,456	60	87,390	74.7	25.3	148	108,642	266	167,420	39.4	60.6	63	23,351	540	188,449	11.0	89.0	70	9,964	4,420	348,608	2.8	97.2
West South Central	310	388,949	94	130,268	74.9	25.1	236	178,908	392	247,489	42.0	58.0	133	51,553	781	266,925	16.2	83.8	98	14,719	3,588	330,818	4.6	95.4
Mountain	152	235,711	36	50,814	82.3	17.7	188	134,725	111	73,798	64.6	35.4	207	75,347	282	96,217	43.8	56.2	266	36,681	2,782	200,369	15.5	84.5
Pacific	211	318,776	5	6,631	98.0	2.0	205	143,379	77	46,026	75.7	24.3	190	81,037	183	60,371	57.3	42.7	360	53,638	1,964	145,922	26.9	73.1
New England																								
Maine	99	152,938	33	44,967	77.3	22.7	75	67,970	79	51,167	57.1	42.9	45	17,426	133	47,682	26.8	73.2	32	5,813	320	43,576	11.8	88.2
New Hampshire	61	93,515	5	6,095	93.9	6.1	51	37,171	36	23,712	61.0	39.0	22	8,049	46	15,817	33.7	66.3	26	3,635	133	18,822	16.2	83.8
Vermont	47	66,981	14	18,647	78.3	21.7	47	34,500	48	34,121	50.3	49.7	52	19,794	65	22,942	46.3	53.7	49	7,280	98	10,961	40.0	60.0
Massachusetts	115	182,181	40	60,904	75.0	25.0	40	30,845	61	40,471	43.2	56.8	23	8,646	85	31,174	21.7	78.3	43	6,713	232	33,995	16.5	83.5
Rhode Island	17	24,510	9	14,293	63.2	36.8	5	4,800	13	9,037	34.7	65.3	9	3,930	11	4,149	48.0	52.0	20	2,876	24	3,093	48.3	51.7
Connecticut	50	78,580	13	19,108	80.4	19.6	25	18,168	31	21,896	45.4	54.6	17	6,541	53	19,993	24.6	75.4	25	2,850	59	9,690	22.7	77.3
Middle Atlantic																								
New York	181	275,988	14	18,590	93.7	6.3	208	142,153	106	69,870	67.1	32.9	254	93,542	281	96,325	49.2	50.8	296	46,268	940	120,040	27.8	72.2
New Jersey	74	114,508	12	15,508	88.2	11.8	55	60,551	51	33,242	64.7	35.3	55	21,263	60	20,636	50.8	49.2	201	28,821	221	29,346	49.6	50.6
Pennsylvania	306	491,133	76	111,788	81.5	18.5	223	168,371	228	146,946	53.4	46.6	206	79,515	382	131,823	37.6	62.4	414	59,850	1,336	161,980	27.0	73.0
South Atlantic																								
Delaware	10	16,926	0	0	100.0	0.0	7	5,033	2	1,765	74.1	25.9	11	4,285	13	4,880	46.8	53.2	16	2,007	47	5,463	26.9	73.1
Maryland	28	42,433	11	11,640	78.5	21.5	32	24,529	24	15,033	62.0	38.0	25	9,826	83	27,879	26.0	74.0	50	6,957	518	45,322	13.3	86.7
Dist. of Columbia	0	0	0	0	0.0	0.0	0	0	0	0	....	....	0	0	0	0	....	....	0	0	0	0	....	....
Virginia	30	46,929	15	22,593	67.5	32.5	28	21,027	48	30,762	40.6	59.4	26	10,418	129	44,222	19.1	80.9	58	8,661	1,881	123,256	6.6	93.4
West Virginia	33	48,248	37	49,011	49.7	50.3	26	20,081	98	60,378	25.0	75.0	18	6,909	182	58,581	10.4	89.6	38	5,599	1,495	117,148	4.6	95.4
North Carolina	51	72,286	26	36,218	66.7	33.3	47	34,912	63	41,219	45.8	54.2	35	13,346	142	48,537	21.6	75.4	54	7,954	1,092	82,137	8.8	91.2
South Carolina	40	62,969	10	15,672	80.1	19.9	27	20,886	26	18,018	53.7	46.3	14	5,405	69	23,499	18.7	81.3	23	3,428	393	34,677	9.0	91.0
Georgia	61	92,197	21	28,365	76.5	23.5	47	35,855	66	44,536	44.6	55.4	26	9,778	201	69,880	12.3	87.7	23	2,915	633	62,650	4.5	95.5
Florida	37	56,149	11	14,015	80.0	20.0	28	21,450	45	31,002	40.9	59.1	25	8,534	108	37,645	18.5	81.5	67	9,458	569	52,187	15.4	84.6
East North Central																								
Ohio	130	197,825	21	33,653	85.4	14.6	146	99,907	72	49,963	66.7	33.3	141	51,789	220	76,687	40.3	59.7	197	28,277	659	79,922	26.2	73.8
Indiana	103	152,263	8	11,325	93.2	6.8	135	96,163	32	19,421	83.2	16.8	110	41,777	141	48,805	46.2	53.8	141	20,138	395	50,811	28.4	71.6
Illinois	208	318,829	9	11,365	96.7	3.3	234	168,034	44	26,568	86.3	13.7	207	79,373	159	53,260	59.8	40.2	260	36,389	494	58,935	38.2	61.8
Michigan	119	183,091	13	18,539	90.8	9.2	119	87,218	49	32,611	72.8	27.2	107	41,195	150	51,178	44.7	55.3	102	5,250	184	23,193	18.5	81.5
Wisconsin	78	121,401	5	6,510	94.9	5.1	163	114,418	26	16,549	87.4	12.6	144	55,082	107	34,127	61.7	38.3	185	25,443	410	44,709	36.3	63.7
West North Central																								
Minnesota	67	134,954	2	2,531	98.3	1.7	125	92,022	14	8,917	91.2	8.8	181	64,505	35	11,674	84.7	15.3	253	35,002	589	49,129	41.7	58.3
Iowa	112	164,725	3	3,869	97.8	2.2	101	142,641	29	20,275	87.4	12.6	210	77,237	62	21,729	78.0	22.0	367	38,962	317	35,422	52.3	47.7
Missouri	120	191,318	4	5,470	97.2	2.8	110	81,813	48	31,213	72.5	27.5	131	49,349	180	60,300	45.0	55.0	89	13,100	1,170	93,885	12.2	87.8
North Dakota	23	33,753	3	3,333	91.0	9.0	51	38,699	10	5,509	87.7	12.3	57	23,513	75	24,676	48.8	51.2	39	7,098	427	45,594	13.5	86.5
South Dakota	27	34,745	1	1,254	96.6	3.4	48	32,783	10	6,593	83.2	16.8	71	25,772	30	10,055	71.8	27.2	35	5,925	357	33,456	15.1	84.9
Nebraska	65	95,901	1	1,214	98.8	1.2	100	69,891	7	4,560	93.9	6.1	129	50,549	50	17,518	74.2	25.8	91	16,204	411	30,896	34.4	65.6
Kansas	82	127,310	2	2,606	98.0	2.0	118	83,999	16	10,934	88.5	11.5	156	56,795	59	20,015	14.0	26.0	116	18,484	486	50,245	26.8	73.2
East South Central																								
Kentucky	49	72,197	14	22,479	76.2	23.8	47	32,921	60	36,666	47.3	52.7	43	8,234	158	54,984	13.0	87.0	25	3,133	2,189	150,108	2.0	98.0
Tennessee	36	52,729	7	9,469	84.8	15.2	36	27,632	62	39,429	41.3	59.7	18	6,997	115	39,827	14.9	85.1	24	3,859	698	65,513	5.6	94.4
Alabama	47	72,091	27	39,999	64.3	35.7	36	26,404	88	56,063	32.0	68.0	10	3,709	157	54,508	6.4	93.6	16	2,243	845	70,743	3.1	96.9
Mississippi	39	61,439	12	15,443	79.8	20.2	29	21,685	56	35,262	38.0	62.0	12	4,411	110	39,130	10.0	89.9	5	729	688	62,244	1.2	98.8
West South Central																								
Arkansas	36	54,682	12	15,356	78.1	21.9	44	31,326	47	30,663	50.5	49.5	18	6,715	177	60,213	10.0	90.0	15	1,994	1,080	90,806	2.1	97.9
Louisiana	22	32,092	24	36,067	47.1	52.9	17	13,587	102	67,186	16.8	83.2	4	1,611	130	42,886	3.6	96.4	8	1,150	713	58,871	1.9	98.1
Oklahoma	87	42,379	11	14,331	74.8	25.2	65	48,162	48	30,010	61.7	38.3	29	10,725	170	60,133	15.1	84.9	36	5,799	577	55,128	9.5	90.5
Texas	165	259,796	47	64,514	80.1	19.9	110	85,833	195	119,630	41.8	58.2	82	32,502	304	103,693	23.9	76.1	39	5,776	1,218	126,013	4.4	95.6
Mountain																								
Montana	18	26,057	4	6,331	80.4	19.6	32	24,131	5	3,767	86.5	13.5	32	11,490	46	15,095	43.2	56.8	30	4,314	703	43,512	9.0	91.0
Idaho	24	37,178	2	2,890	92.9	7.1	36	24,430	15	10,072	70.8	29.2	66	23,663	39	12,379	65.6	34.4	42	5,760	286	19,194	23.0	77.0
Wyoming	11	17,847	3	3,565	83.3	16.7	14	10,446	8	5,272	66.5	33.5	16	5,662	14	5,250	51.8	48.2	10	1,480	322	24,202	5.8	94.2
Colorado	29	47,336	5	6,913	87.3	12.7	42	29,134	18	11,828	71.1	28.9	34	11,821	51	16,750	41.3	58.7	61	7,843	556	42,149	15.7	84.3
New Mexico	12	16,680	13	17,207	49.2	50.8	5	3,231	35	23,769	12.0	88.0	4	1,459	62	22,472	6.1	93.9	7	1,025	423	25,149	3.9	96.1
Arizona	13	19,348	4	5,239	78.7	21.3	9	5,632	12	8,050	41.2	58.8	3	1,245	23	7,558	14.2	85.8	10	1,494	204	15,124	9.0	91.0
Utah	38	57,937	5	8,669	87.2	12.8	43	32,053	13	8,003	80.0	20.0	41	15,885	32	11,083	58.8	41.2	91	12,846	158	20,078	39.0	61.0
Nevada	7	13,328	0	0	100.0	0.0	7	5,668	5	3,037	65.2	34.8	11	4,120	15	5,630	42.2	57.8	15	1,919	130	10,961	14.9	85.1
Pacific																								
Washington	45	67,010	3	3,817	94.7	5.3	51	37,563	26	14,999	71.5	28.5	54	19,999	83	27,396	42.2	57.8	57	7,609	580	45,536	14.3	85.7
Oregon	27	41,992	2	2,814	93.6	6.4	36	26,038	6	3,367	88.7	11.3	46	16,879	16	5,178	76.6	23.4	78	10,607	546	30,675	25.6	74.4
California	139	209,774	0	0	100.0	0.0	118	79,778	45	27,660	74.5	25.5	90	44,159	84	27,797	61.3	38.7	225	35,422	838	69,711	33.7	66.3

* Includes only towns of such importance as to have a post office or city postal service.
† In this instance "Urban Population" includes the population of all cities, towns and villages having post offices or city postal service regardless of size of town.

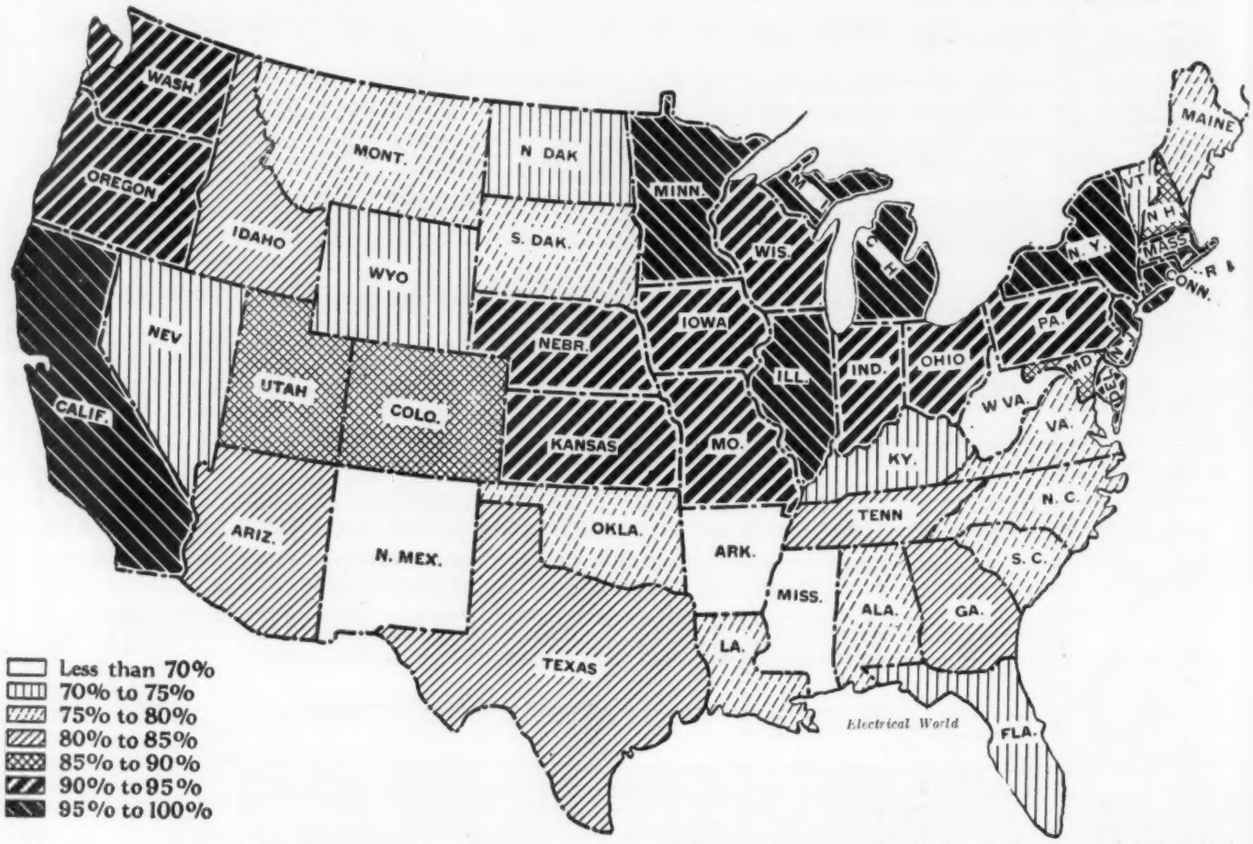
lamps until they attain a population sufficient to warrant a local generating plant or until a new transmission system is constructed from which they can obtain electric service.

NINETY PER CENT OF URBAN POPULATION SERVED BY CENTRAL-STATION SYSTEMS

In the study of present and future central-station development, however, the aggregate population of the towns served and not served, rather than the number of towns in each class, is the basic figure of leading importance. The fact that more than 36,000 towns are not reached by central-station lines, as against approximately 17,000 towns served, is of minor importance when the statement is further augmented by the fact that the aggregate population of this large number of towns not served is under 7,000,000, while the aggregate population of the towns served is over 65,000,000. In other words, the central station is now serving more than 90 per cent of the population of the country which has congregated into communities of appreciable size. This percentage, then, represents the present field of the central station in the country as a whole. There are certain additions, however, which must be made when the field is considered by sections. For instance, in the Pacific States the irrigation and oil-field load extends the field beyond the concentrated centers, and in the Mountain States the mining load must be taken into consideration. Other sections have specific qualifications.

With the exception of the farming and mining industries, probably 95 per cent or more of the present and potential industrial load of the central station is concentrated in the 16,642 cities, towns and villages reached by central-station lines. As indicated above, 90.6 per cent of the population of all cities and towns is also included in the towns now reached by central stations. It would appear, therefore, that the communities now reached would serve as a fairly accurate barometer of the present and future activities of the electric light and power industry.

The population of the cities and towns now served by central stations totals 65,633,719. These figures are, however, for the census year of 1920. Assuming a yearly population growth in the country of 1,300,000



PROPORTION OF TOTAL URBAN POPULATION LIVING IN CITIES AND TOWNS SERVED BY CENTRAL-STATION DISTRIBUTING SYSTEMS

and that 62 per cent of this is concentrated in the cities and towns now served by central stations, then the total population of these cities and towns on January 1, 1925, may be taken as 69,800,000, which, translated into possible central-station purchasing units, gives 16,700,000 homes or families.

LARGE PART OF DOMESTIC LIGHTING LOAD UNDEVELOPED

All these urban families, however, cannot be considered as potential central-station customers—that is, for years to come. There are certain sections of New York City, for instance, which are now lighted with gas and which the local distributing companies do not consider potential territory for electricity, and similar conditions exist in other cities. There are, however, probably 16,000,000 homes or families in these cities and towns which are at present possibilities as central station customers. Assume that 12,100,000, or 95 per cent, of the estimated present number of domestic lighting customers dwell within the limits of these cities and towns. This would leave a total of 4,600,000

homes on the first of the year which afford possibilities for future electrification. In addition to this it must be remembered that the number of homes or families in these cities and towns is increasing at the rate of approximately 200,000 per year. The central station has, therefore, for its 1925 bogey a total of almost 5,000,000 homes for future electrification.

It appears from the above conclusions that, even without the addition of new towns served, the central station has a large domestic lighting field to be developed and that this development will extend over a number of years. The future education of the public in effective home lighting and in the extended use of domestic electrical apparatus will also tend to build the domestic lighting load beyond that which would result from the mere addition of new customers.

Commercial Lighting and Industrial Power Field Looms Large

The commercial lighting field is also full of large possibilities for development. The past year has been a record one for the construction of stores and office buildings, and virtually all new commercial construction is now electrically equipped. This part of the central-station load should witness a steady increase during the coming years.

The industrial load of the country is estimated at approximately 62 per cent electrified, of which approximately 65 per cent is carried by central stations and 35 per cent by private electric plants. The opportunities for the growth in the industrial load of the central station appear even greater than those of the lighting load. New industrial uses for electrical energy and the further electrification of railroads also open up vistas of potential industrial developments.

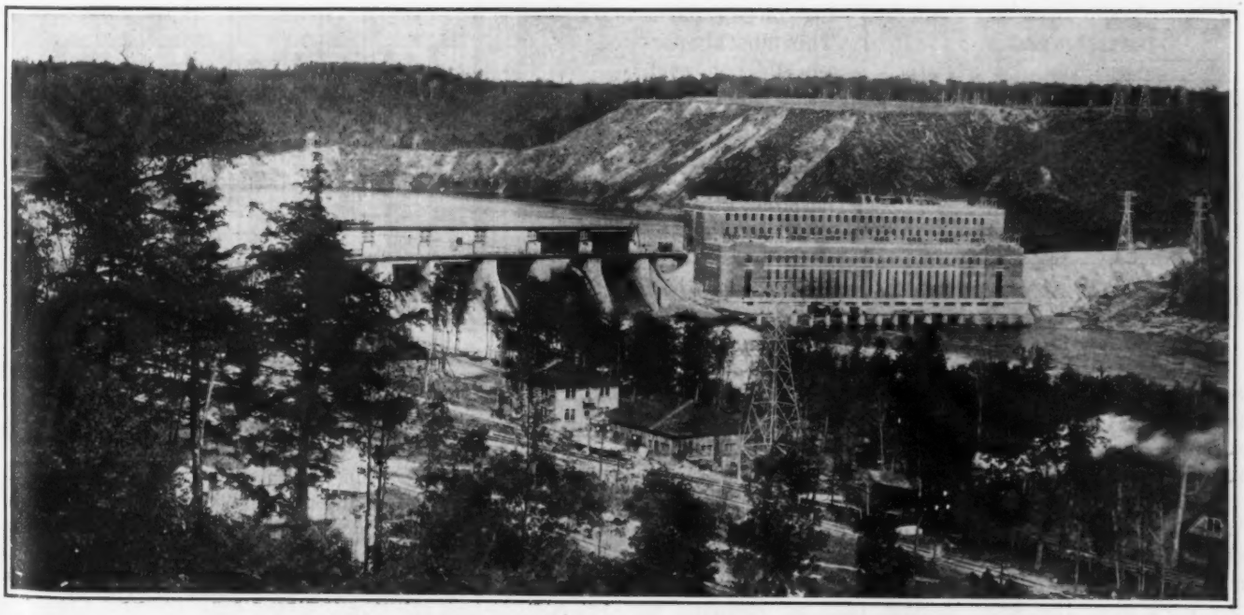
Industry Has a Large Future

Despite its rapid growth and the high place it has already attained in American life, therefore, the electric light and power industry has a large future before it. Those who prophesy a dwindling of central-station growth in the near future have not obtained a national view of the industry and its field. True, the great record for annual growth set in 1923 may never be attained again, but the new load added that year was abnormal, a "hangover" from the war and the period of high prices. Increased illumination in the home and office, increased street lighting, increased use of electrical appliances, increased use of power on the farm, new and today unthought-of industrial applications make available a potential central-station field the size of which makes the present development seem like a mere beginning. That the operations of the industry will continue to grow for many years is a certainty.

Parliamentary Report on Low-Temperature Carbonization of Fuel

IN A RECENT report of the Committee of the Privy Council for Scientific and Industrial Research presented to the British Parliament the following paragraph is of interest to American readers:

"Low-temperature carbonization of coal is attractive, since it produces both smokeless solid fuel useful for domestic and industrial purposes and a supply of motor spirit and of liquid fuel needed for the navy and mercantile marine. It would not be a specific for all our troubles even if it could be profitably adopted for the 40,000,000 tons of coal annually used in domestic fireplaces. Owing to the variation in the coals available and in the local conditions, a number of different processes will possibly have to be devised before success on a national scale is achieved. It is quite certain that no single process has yet become established which would be suitable for application on a national scale. Before it would be feasible to prohibit the use of raw coal in our homes, it is therefore necessary to find a process and a type of plant—or a number of processes and types of plant—which, collectively, would pay their way when the raw coal is purchased at approximately the same price as coal now sold for household or other general purposes."



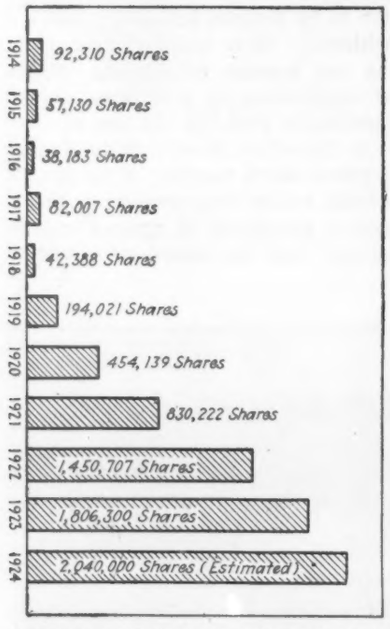
THE LA GABELLE HYDRO-ELECTRIC PLANT AT SHAWINIGAN FALLS HAS UNITS TOTALING 150,000 HP. OPERATING UNDER A HEAD OF 60 FT.

Customer-Ownership Sales

Stock Purchases Directly by Customers During 1924 Estimated at $194,200,000—More than Two Million Shares Involved in the Sales

THE direct sale of securities to customers and employees by electric light and power companies has come to be one of the most promising activities of the electric light and power industry. The art of cultivating the good will of the public has come to be thought as essential a part of the business as the manufacture and sale of goods. Customer ownership means more for the stability and permanence of investments in central stations, more for the promotion of a proper understanding between the company and its customer partners, than any other activity of the industry.

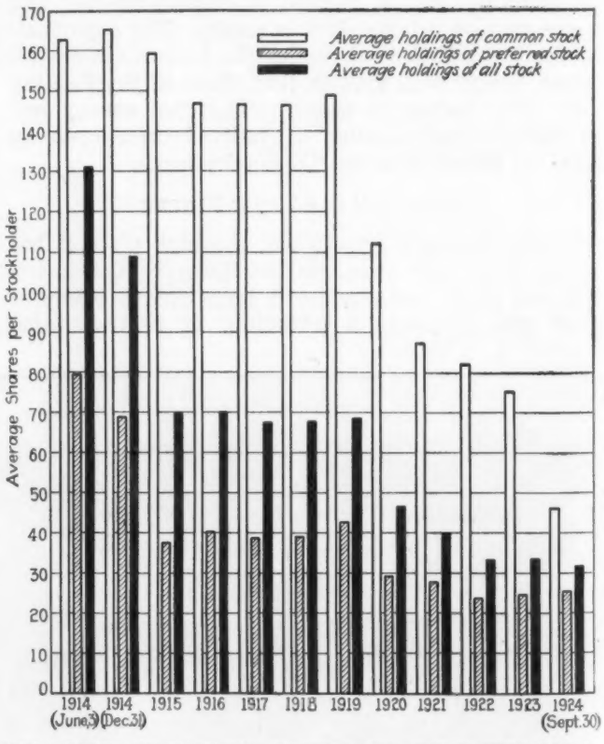
National data on the sales of central-station securities to customers and employees have been meager. The customer-ownership committee of the National Electric Light Association in its annual reports has given valuable information on shares sold, stockholders obtained and the cost of conducting sales campaigns, but few data on the value of the stock sold have been made available. To fill this void in the statistics of the industry the ELECTRICAL WORLD during the past year has requested the companies selling stock to customers and employees to report their monthly activities, giving the number of shares sold, the total value of the stock sold and the number of customers and employees buying stock during the month. These reports have been tabulated and estimates made of the total customer-ownership sales of the industry based upon the activities of the companies reporting their sales. This monthly survey did not reach full momentum until after the summer months, so that it is impossible at this time to give any definite picture as to the monthly trend in central-station customer-ownership sales. Some very interesting conclusions, however, will be possible at the close of the present year. During the summer the total value of the stock sold is considerably under that sold during the remainder of the year.



CUSTOMER OWNERSHIP HAS SHOWN A STEADY GROWTH SINCE 1918

Based upon reports received by the ELECTRICAL WORLD from April through October, it is estimated that during 1924 a total of 2,040,000 shares were sold on the customer-ownership plan. This is an increase of 13 per cent over the sales during 1923 as reported to the National Electric Light Association. The value of the sales is estimated at $194,200,000, or at the average rate of $95.25 per share. The total new capital added to the central-station industry during 1924 is given elsewhere in this issue as approximately one billion dollars, so that the security sales direct to customers were about 19.5 per cent of the total security sales. It is also estimated that 307,500 purchases of stock in all were made. By reason of the fact that data have not been returned on the proportion of the 307,500 purchasers who made more than one purchase, it is impossible to arrive at the actual net number of shareholders obtained during the year. It is believed, however, that the figure of 300,000 would, with a fair degree of accuracy, represent the number of individual customer sales during that period. Based upon former reports, this would make a total of approximately 950,000 customers and employees now holding electric light and power securities purchased directly from the operating companies. In other words, approximately 8 per cent of all the central-station domestic lighting customers in the country are holders of stock.

Among the many new issues of stock sold under the customer-ownership plan during 1924 perhaps the offer of 50,000 shares of common stock by the Pacific Gas & Electric Company possessed the most significance. This company was the pioneer in the sale of preferred stock to customers, and its determination to sell common stock also direct to consumers makes even more valid the aim of this company, as well as the spirit of



BY A WIDER DISTRIBUTION OF ITS STOCK THE PACIFIC GAS & ELECTRIC COMPANY HAS FULLY TAKEN THE PUBLIC AS A PARTNER

the West, to make "the public a partner." This was not, however, the first instance of common stock being offered to customers by electric light and power companies. The Commonwealth Edison Company of Chicago, the Narragansett Electric Lighting Company of Providence and the Consolidated Gas, Electric Light & Power Company of Baltimore have all, at one time or another, distributed common stock in their territory.

Developments in

Electrochemistry and Electrometallurgy

By H. C. Parmelee
President American Electrochemical Society

THE electrical industry is interested in electrometallurgy and electrochemistry primarily as outlets for energy. The electric furnace appears to have reached a stage where larger development and more extended use are limited by the quality of refractories for furnace linings. Metallurgists would welcome an opportunity to work at temperatures as high as 3,000 deg. C. and believe that new products of industrial value could be made under those conditions. It has been proposed to use water-cooled refractories, like magnesite and dolomite, entailing a considerable loss of heat in order to reach higher temperatures and to gain speed in operation. Among the metals that have recently gained commercial importance as electric furnace products are the low-carbon steels containing chromium, vanadium and tungsten.

In the field of electrodeposition of metals, zinc production has gone ahead rapidly in spite of pessimistic predictions and earlier prophecies to the contrary. The daily production at Anaconda is now about 200 tons, at Trail, B. C., 125 tons, and in Tasmania 75 tons. Electrolytic nickel has not gained much ground as it still meets a serious competitor in the product of the Mond process.

Some progress has been made in the production of metals by the electrolysis of fused salts, and there is considerable promise in this branch of electrometallurgy. Aluminum, the strongest competitor of copper in the electrical industry, is the outstanding example. Magnesium, however, is now being made by a similar process and has suddenly assumed industrial importance, being available in large quantities at a reasonable price. The demands of radio have led to the electrolytic production of metallic calcium for use in evacuated containers. It is also used for the purification of argon. Magnesium, which forms the silver-like lining in radio tubes, is likewise an electrolytic metal. Beryllium is a newcomer in this field and is the result of research for light metals and alloys of a high tensile strength for aeronautic construction.

A future development of importance in electrochemistry is likely to occur in the fertilizer industry as a direct result of the demand for concentrated fertilizer. Phosphoric acid is now made by the electrothermic treatment of phosphate rock, and the fixation of nitrogen as ammonia will probably call for new development in hydrogen cells.

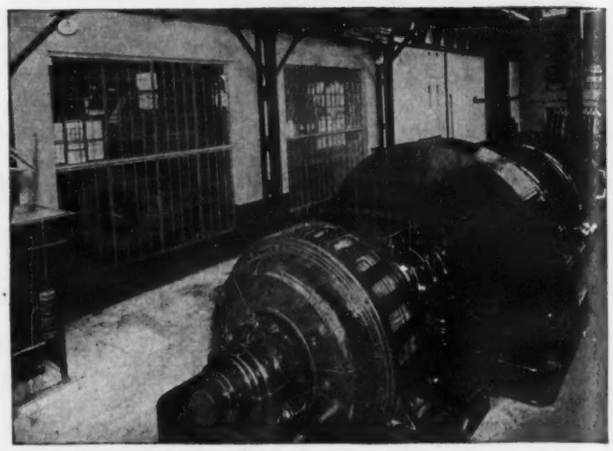
Industrial electric heating has made rapid strides during the past year and seems destined to find wider application as its advantages become more widely appreciated.

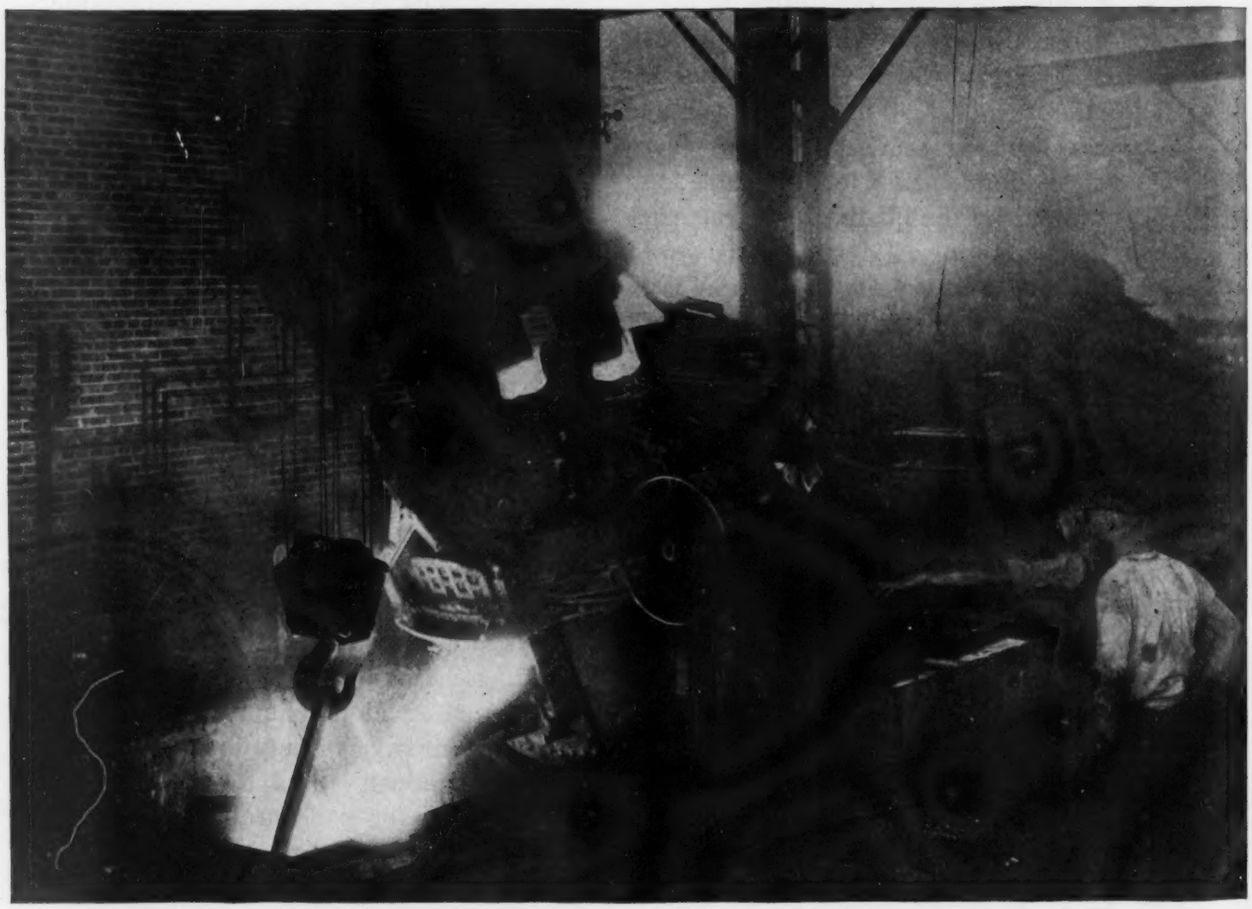
Progress in the Metal Industries

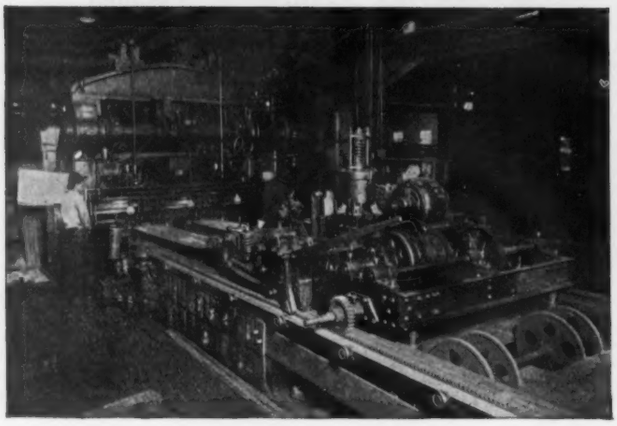
STEADY progress is being made in the electrification of the steel industry. Furnaces for refining metals, for making alloys and for foundry work are now established, and the coming year should see many new installations. Control equipment for furnaces has been improved, electrodes of a superior type are available, and a better understanding of the possibilities of the electric furnace is had. In the brass industry electric furnaces are rapidly gaining the field to themselves.

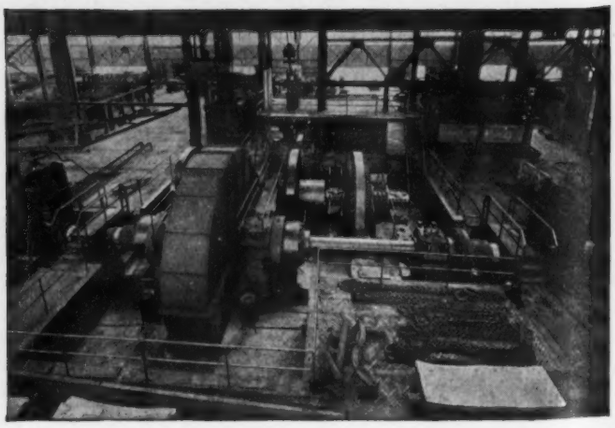
In steel mills both alternating-current and direct-current drives have been installed during the year. Refinements in speed control have been made, and electricity has been adopted for several new processes. The interchange of energy between steel mills and central stations has received careful consideration during the year, and several contracts are contemplated.

Upper right—A 7,000-hp. motor-generator flywheel set for supplying a blooming mill. Center—Pouring from a modern melting furnace. Lower left—A modern electric riveter. Lower right—A steel-mill installation using gear drive.









Central-Station Commercial Progress

Present Market Possibilities Represent Two-Billion-Dollar Annual Revenue—High-Load Factor Business Needed—Shall This Service Be Sold Now or Twenty Years Hence?

By T. P. KINDIG
Assistant Editor ELECTRICAL WORLD

WITH the substantial prosperity of the central-station industry, so apparent during the year just closed, has come a realization on the part of executives and commercial men that in the building of additional load through expansion of electric service utilization only the surface possibilities have so far been penetrated. New business has come to central-station companies in recent years in such a volume that there is not a single electric utility that has not been hard pressed to find capacity to meet the demands upon it. Much additional generating, transmitting and distributing capacity has been installed, and commercial organizations have of necessity given their efforts largely to the routine work of connecting new customers and new loads which were clamoring for service.

During this time there has been an honest and a consistent effort on the part of utilities for a better understanding of their problems by the public. It became increasingly apparent in 1924, as was predicted by the ELECTRICAL WORLD at this time last year, that the ultimate solution of all public relations problems lay in broadening and increasing the use of service by the individual customer. After all, good will is the direct result of adequate sales service.

LOAD BUILDING BUSINESS NEEDED

Throughout this period and as a consequence of existing conditions central-station commercial men have had little or no time for careful study looking to the selective development of new business with respect to its desirability as to load factor, power factor, revenue per kilowatt connected and other characteristics. In the meantime investment costs per unit of system capacity have been mounting, with their accompanying increased fixed charges, until it has become imperative that the commercial man shall not only add more business but shall concentrate on those classes which because of favorable load factor or off-peak operation will make for greater use of existing plants.

At the request of the ELECTRICAL WORLD, W. R. Putnam, chairman of the Commercial Section of the National Electric Light Association, has briefly set forth these most urgent commercial problems of the central station companies with some fundamental suggestions for their solution.

LOAD FACTOR MUST BE RAISED

"Central-station companies," Mr. Putnam says, "have been confronted with a most serious problem of peak prices for all new construction work, starting at the war period and continuing up to the present time. There has been little if any recession in the cost of generating, transmission or distribution equipment during the last five years, while the increasing demand for service has necessitated large extensions of plants and systems, so that at least 50 per cent of the present investment of an electric light and power system has been made at these high prices. The average cost per kilowatt of system capacity has increased more than 60 per cent. With a constantly increasing percentage of their investment made up of high-cost construction, companies are faced by the dilemma of either increasing their rates to meet the greater fixed charges or making this increased investment work longer hours; that is, increasing the load factor of their plants. To increase rates is not only difficult but also undesirable from a public relations standpoint. Raising the entire system load factor offers the best and most economical solution.

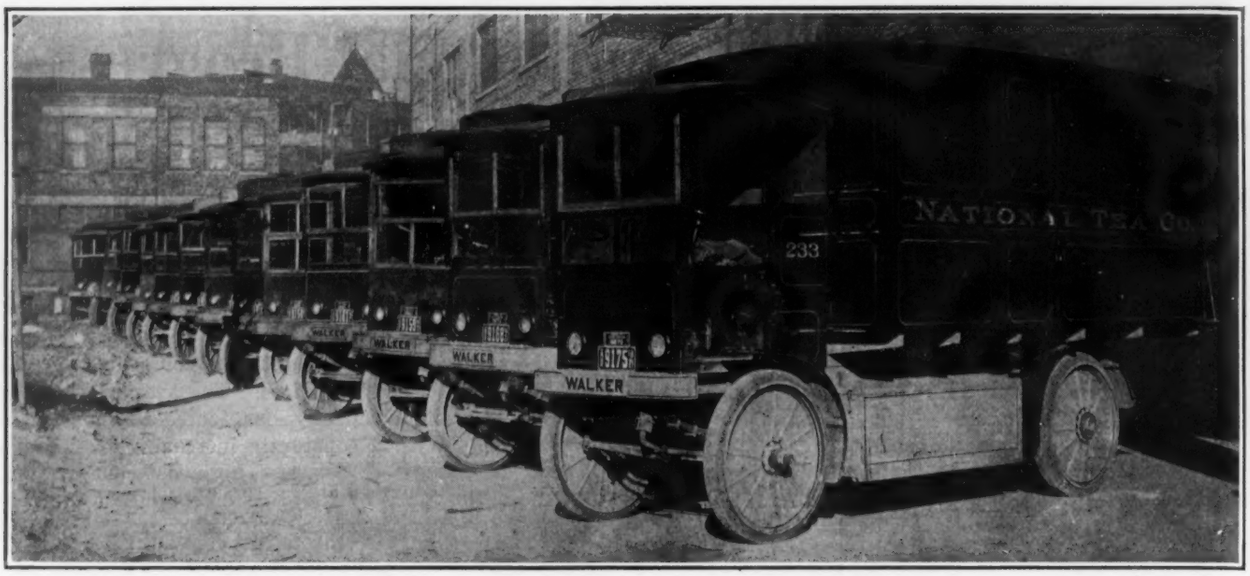
"To illustrate: The cost of building large steam-power plants has increased during the last ten years from approximately $80 per kilowatt of capacity to $125 per kilowatt. Notwithstanding the enormous growth in load served, the load factor of the generating station has either remained stationary or has declined, and in few instances is it more than 45 per cent. If it were possible to increase this load factor to 60 per cent, it would be equivalent to bringing the investment cost back to the former figure of $80 per kilowatt.

"It appears to me that the most urgent problem which confronts all central-station men, and commercial men most particularly, is that of so directing their load-building efforts as to raise the system load factor and by this increased efficiency offset the higher unit investment cost and increases in operating expenses caused by higher costs for wages and supplies.

CAUSES OF PRESENT CONDITIONS

"The present situation is the result of several contributing causes. One of the chief difficulties has been that new business has come to the central station so fast that there has been no time to consider whether or not a certain class of business was desirable—the principal question has been to find sufficient capacity to supply service. Central-station commercial men have, perhaps, taken too much for granted, thinking that business must come to them as a matter of course. This commercial inertia has, in effect, failed to keep pace either with the growing demand for service or with the increased capital investment. As a matter of fact, commercial men have not been diligent in analyzing their market and taking steps to obtain the proper balance in new business secured so as to build a high station and customer load factor.

"The backward development in street lighting serves as a striking example, and conditions in a certain city illustrate this point forcibly. In 1912, out of $136 received in taxes on each $10,000 valuation, the city spent 47 cents for street lighting; but in 1922, while the tax per $10,000 valuation had increased to $240,



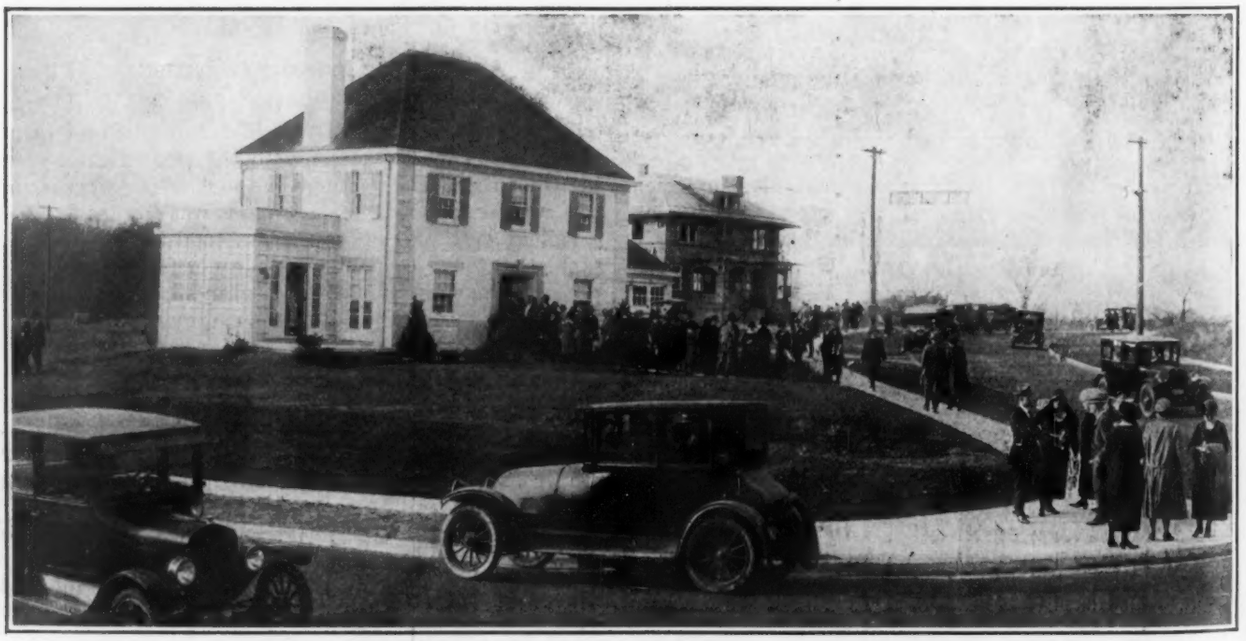
LARGE FLEETS OF ELECTRIC TRUCKS ARE BEING SOLD WHERE TRAFFIC PROBLEMS INDICATE THEIR ECONOMICAL APPLICATION

that city's street-lighting expenditure had dropped to the rate of 35 cents. So the local central-station company, instead of enjoying a proportional gain of 76 per cent in street-lighting revenue, had in effect fallen behind by 25 per cent.

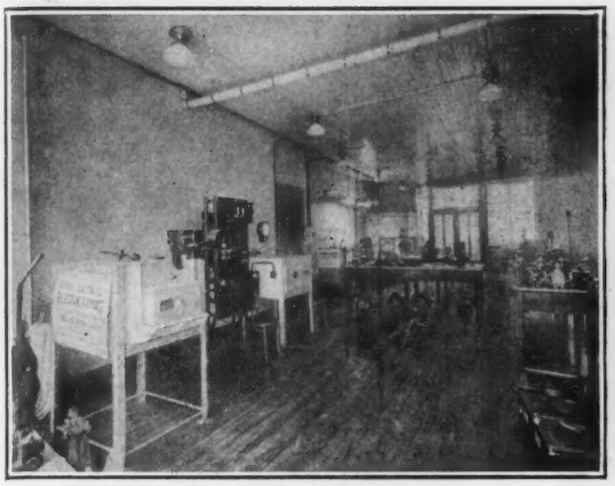
"Of equal importance is the fact that in the last five years five million newly wired homes have been connected to the lines of the central-station companies, but whereas five years ago 25 per cent of the homes were adequately supplied with appliances, now only 18 per cent are so equipped. The resulting effect on system load factor is apparent.

"It is possible, of course, to improve system load factor somewhat by shifting the power customer's hours of operation and encouraging off-peak business, but the real solution lies in improving the load factor of the individual customer, whether residential, commercial or a power user, and in concentration on those classes of business which will help to fill in the valleys of the load curve.

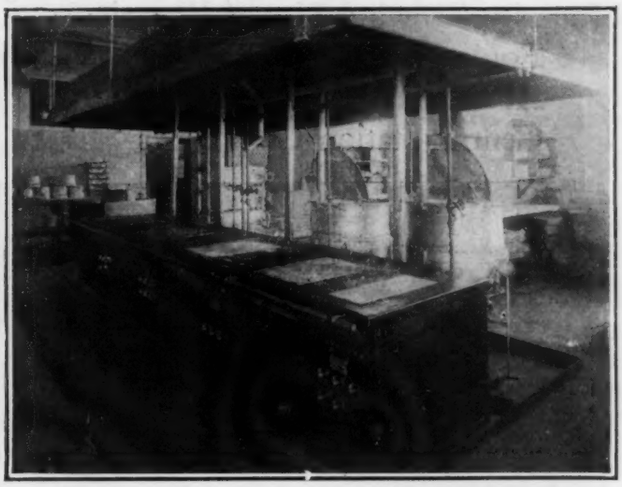
"The work of the Better Home-Lighting Educational Committee during 1924 has been one constructive step in the direction of improving the load factor of those customers who make up the larger part of our total. The committees of the Commercial Section of the National Electric Light Association are likewise working to determine by what classes of business system load factor can be improved. This is particularly notable in the work of the electric cooking and heating committees, in connection with the domestic range survey now in progress in the Northwest, the work of the appliance committee, the work of the sub-committees of the power committee, in connection with the study of commercial cooking load, and in the work of the



MANY REPLICAS OF THE $15,000 FIRST PRIZE IN THE NATIONAL BETTER HOME-LIGHTING CONTEST WERE EXHIBITED THROUGHOUT THE COUNTRY. THIS ONE WAS OPENED IN DAYTON, OHIO



NEW INDUSTRIAL ELECTRIC HEATING SHOWROOM OF THE ROCHESTER (N. Y.) GAS & ELECTRIC CORPORATION



ELECTRIC RANGES, PART OF A 143-KW. HEAVY-DUTY ELECTRIC COOKING INSTALLATION

transportation committee and of the street-lighting committee.

"That the electric light and power companies will continue and increase their activity in the sale of energy-consuming devices is certain. Their primary interest is to build load, and the sale of domestic appliances is one of the most direct means of widening the use of electric service. Companies should, however, conduct their merchandising departments on a profit-making basis, not only that they may be self-supporting in themselves, but because where the central station sells appliances on this basis it has been conclusively proved that electrical contractors and other dealers sell more electrical merchandise.

"Commercially, central-station companies should make a careful analysis of the present condition of their load curve, to determine what classes of business can be taken on at the lowest or without any additional investment, and then map out and follow through a sales program which will increase the system load factor and increase the use of energy by the individual customer."

Means at Hand for Building Load

That there are means at hand for rapidly putting further profitable and diversified load on the distribution lines of the central station is shown by a brief survey of the past year's notable developments.

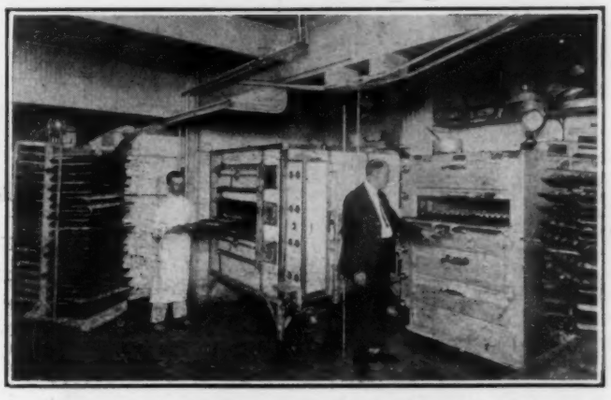
Industrial electric heating offers probably the biggest single opportunity for increasing the kilowatt-hour consumption of energy. It is stated by heating engineers that there is one or more operation in every manufacturing plant in which electric heat can be most economically applied. They also estimate that the potential possibilities of this load equal or even exceed the present motor load. The work of the N. E. L. A. power committee in conjunction with the electrical manufacturers in conducting industrial electric heating courses for central-station power sales engineers has been a noteworthy step in promoting this business.

Residential, commercial and street lighting have undergone a rejuvenation in the last twelve months. The national "better home-lighting" essay contest was, of course, the most spectacular event of the year, but central-station companies generally are putting forth more direct efforts to build up this load by forming lighting service departments. The courses of instruction in illuminating engineering which are being conducted by the lighting committee of the N. E. L. A. in conjunction with the Illuminating Engineering Society are providing the central station with men properly trained to carry on this work. It is interesting to note that where a year ago nineteen companies had a lighting sales organization there are now sixty-three companies with such departments.

To promote the sale of electric trucks several companies have organized special departments to handle this business. Another most commendable step has been taken by the N. E. L. A. transportation committee in recommending the sale of electric trucks only after definite investigation of traffic problems indicates their economical application. When it is considered that virtually all battery charging comes at off-peak hours and that each truck represents from $25 to $45 monthly revenue, this load at once becomes very attractive to the central station.

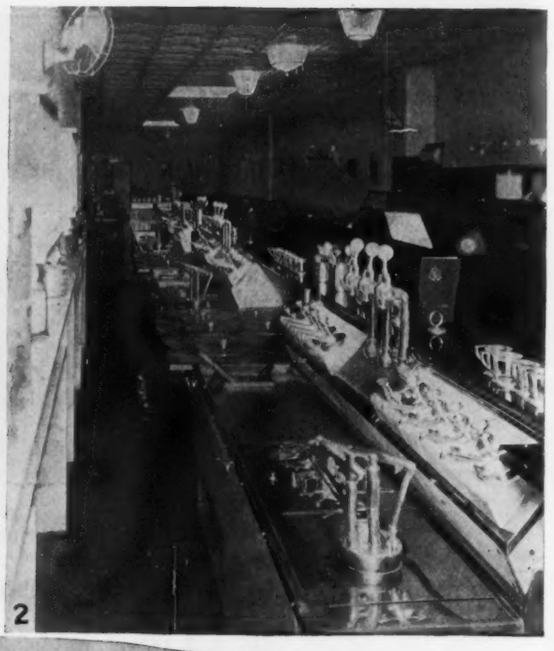
In the sale of domestic appliances central-station companies have still a long way to go. Existing customers, it is estimated, have on the average invested about one-fourth the amount in electrical conveniences that they should have invested to enjoy full benefits of electric service. Every home represents a potential market for $500 worth of appliances, but with the vast number of new customers which have been added it has been impossible to keep pace with opportunities.

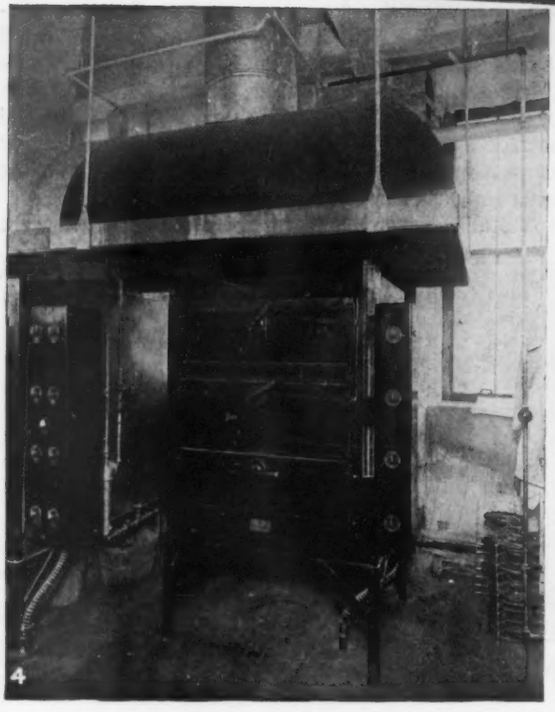
Two notable developments in the appliance field were

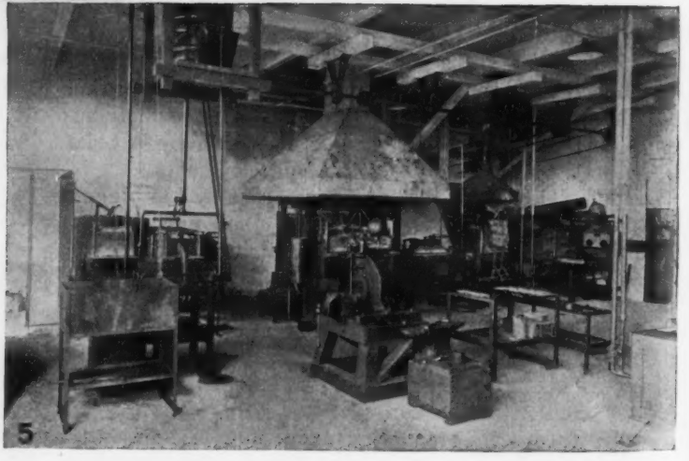


ELECTRIC OVENS ARE EFFECTING ECONOMIES IN TIME AND MONEY FOR THE BAKER

Rapidly Growing Use of Electrical Equipment Is Building Additional Load and Revenue for Central-Station Companies







No. 1. Electric furnace for continuous heat treatment of steel wire.

No. 2. Small electric refrigerators for use in ice-cream parlors and in the home are developing into one of the most attractive loads for electric light and power companies.

No. 3. A 100 per cent electric range installation. Each of these sixteen homes in Lochearn, a suburb of Baltimore, is equipped exclusively for electric cooking.

No. 4. Electric bake ovens and heavy-duty restaurant equipment are building a well-diversified and profitable load.

No. 5. Complete electrical equipment for heat-treating carbon and high-speed steels installed in Henry Disston & Sons' new Seattle plant.

made in 1924 which promise large returns in revenue. In the study and investigation of the electric range now being made in the Northwest reliable data on the characteristics and value of this load will be determined. Once this information is available, it will set at rest many moot questions as to the cost of serving this class of business and enable central stations to devote their efforts to selling the range rather than trying to determine whether or not it is profitable business. Depending on the rate in different communities, this appliance offers an annual revenue of between $50 and $90 per customer.

Rapid development of the domestic electric refrigerator has brought about the acceptance of this device by many central-station companies, and it has been lately predicted that the sales of electric refrigerators during 1925 will equal the total number that have been sold in the five years just previous. Accompanying the household type has been the production of a small refrigerating unit for use in ice cream cabinets. Both of these devices can be installed on the customer's lighting circuit without additional investment on the part of the central-station company, and the annual revenue ranges from $100 to $200 per kilowatt connected.

A typical picture of the fertile possibilities for expansion of electric service in the home which will result in more energy consumption and increased revenue to the central-station industry is presented in the following year-end review of conditions in Boston by C. E. Greenwood, superintendent appliance department of the Edison Electric Illuminating Company of Boston.

Residential Market Far from Saturation

"Year by year," says Mr. Greenwood, "the 'electrification' of the home advances with longer strides. Cumulative successful use of appliances, coupled with expanding sales effort by the central station, has produced new business in increasing volume, and the market seems as far from saturation as ever. On December 31 this company closed the biggest appliance year in its history both in gross and net returns from departmental operations. The same conditions hold true elsewhere, notwithstanding the fact that the year just ended was none too good in general business.

"Interest is focused on electric ranges, electric refrigeration and radio as we turn the corner. In all these fields there is a very marked tendency toward expansion. I believe that 1925 will see a striking increase in domestic refrigerating apparatus sales over those of the past three years. Refrigeration will give from $100 to $200 central-station income per kilowatt of system capacity annually in domestic service. Manufacturers are broadening lines of reliable equipment, and the low demand of the motors averaging ¼ hp. is a boon from the standpoint of nominal or negligible wiring installation cost.

"Use of the electric range, it is true, has not grown so fast in the past year as was desirable, but our total range sales were 58 per cent ahead of 1923. The superior cleanliness and safety of the electric range are overcoming the handicap of its higher development cost and multiplying installations where quality service is the key to the customer's buying power.

"Even our restricted experience in radio retailing with a limited line indicates that 1925 will see from 50 to 100 per cent increase in sales. I believe that we may soon expect reliable devices which will take energy to operate radio sets direct from lamp sockets. From every point of view the increased contact with the customer due to radio is to be welcomed, and the addition of this line of merchandise by central-station appliance departments appears to be a logical step in advancement."

Commercial Departments Undermanned

The field for additional power load has been analyzed by V. M. F. Tallman, chairman of the N. E. L. A. power committee, as follows:

"To realize even one-quarter of the opportunities 1925 offers in power business central stations must rid themselves of overcomplacency. Rates must be better designed to meet concrete problems of power economics under acutely competitive conditions. The commercial departments want to be adequately manned for organized service along broader lines to the public than many companies have maintained in the past. They should also have enough high-quality, well-paid men so that they may act as real ambassadors for their company, cultivating the acquaintance of the leaders of their communities and helping to build public relations that cannot be measured in dollars and cents.

"The field for additional load in 1925 appears almost unlimited. Commercial illumination has long been neglected. Heavy-duty electric cooking is barely touched. Sign lighting solicitation is notoriously undermanned. More than 1,500,000 kw. in industrial electric heating has been connected to the lines of central-station companies and only a start has been made. An enormous amount of all classes of business is available if the electric light and power industry will but equip itself with a sufficient sales organization to go out and sell the service which it has to offer."

In the opinion of Arthur Williams, vice-president in charge of commercial relations of the New York Edison Company, the year 1925 is especially full of commercial promise for the central-station company. One of the most important sources of profitable new load is a better public appreciation of the possibilities of light in the decoration of the home. This, if encouraged along the right lines, will lead to doubling and trebling the wattage of residential lighting. Mr. Williams believes that in a program for business development consideration of methods for reaching the small consumers is of paramount importance. This class of business makes up a large share of a company's revenue and acts as a bulwark of security in any time of depression when industrial or commercial consumption of energy may drop off. Furthermore, the small user in the aggregate is the central-station company's biggest field for development and should be carefully and intelligently cultivated.

Commercial Problem One of Selective Selling

The central-station company's commercial problems have been admirably summed up by Charles J. Russell, vice-president in charge of the Philadelphia Electric Company's commercial department, who has made a careful study of new-business development over a long period of years. The loads now served by central-station companies, he believes, represent a growth that has followed a natural external course rather than a carefully planned and vigorously executed policy of selective selling. New business as taken on has meant additional system capacity, and under the present industrial, commercial and living conditions the probable

maximum load factor that can be hoped for in any metropolitan district is between 47 and 48 per cent. Such available loads as street railways and electrification of suburban steam railroads, while offering additional business, will not help to raise the system load factor. The most promising field lies in the development of electrochemical and industrial heating loads for strictly off-peak operation. There must also be made a careful study of every possible class of business to determine along what lines commercial efforts shall be directed, not only among industrial and commercial users, but particularly among residential customers, for whom a large investment in distribution system has already been made.

This kind of commercial work, Mr. Russell has pointed out, cannot be carried on unless there is proper recognition of the importance of this branch of the industry. So long as the commercial department is to be held responsible for the sale of service, it should, in all matters of policy and development of business, be accorded a weighted average of at least 50 per cent as far as importance and authority are concerned, instead of the 10 per cent or less now granted to it.

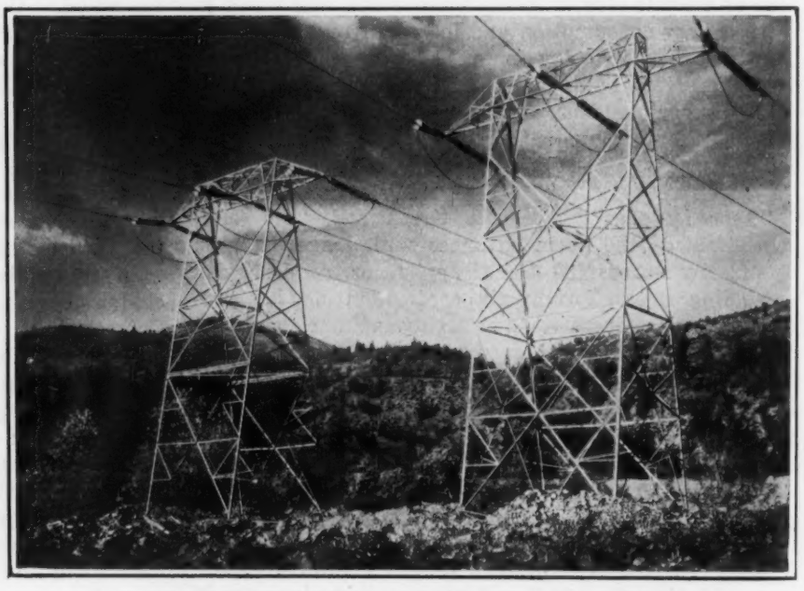
SHALL SERVICE BE SOLD NOW?

It is conservatively estimated that the present market for the sale of electrical energy not yet developed represents an annual revenue of more than two billion dollars as against a gross revenue to all central-station companies last year of $1,335,100,000. At the present rate of development, eliminating normal growth, it will require twenty years to satisfy the market which now stands ready to absorb this service. This situation brings squarely before the central-station industry the question, how quickly can these existing markets for service be developed and will the existing commercial staffs of central-station companies accept this responsibility now, or shall it be left to the following generation?

Transmission Practices Tabulated

THE compilation of complete technical data on high-voltage lines in the United States will be welcomed by the industry because of the plans under way in all parts of the country to interconnect stations and systems. The data contained in the insert in this issue were compiled from original sources by the statistical department of the ELECTRICAL WORLD and represent the existing practices in this country.

A complete analysis of these data cannot be made and would be of little aid, but it is thought a study of different lines now in operation will make existing practices clear to those interested and afford practical aid in the design and installation of a projected line. Some general conclusions can be drawn regarding trends and the state of the art. Briefly, these may be outlined as follows:



PACIFIC GAS & ELECTRIC COMPANY'S 220-KV. LINES IN CALIFORNIA

1. Each utility has designed and installed high-tension lines to meet local operating and economic conditions, and there is no such thing as standard practice in high-tension transmission.

2. Conductors for transmission systems are made of several different materials, with copper, aluminum and A. S. C. R. predominating. Stranded, solid and specially fabricated conductors are used on lines at the several voltages listed.

3. The majority of transmission lines in this country operate as grounded systems without ground resistance. Several recent installations use a low resistance ground; one system has operated for years with a ground resistance of 1,000 ohms, and many systems operate without any ground.

4. Standards in sags, clearances, spans and stringing tensions are not evident in existing systems, and great differences exist in practice.

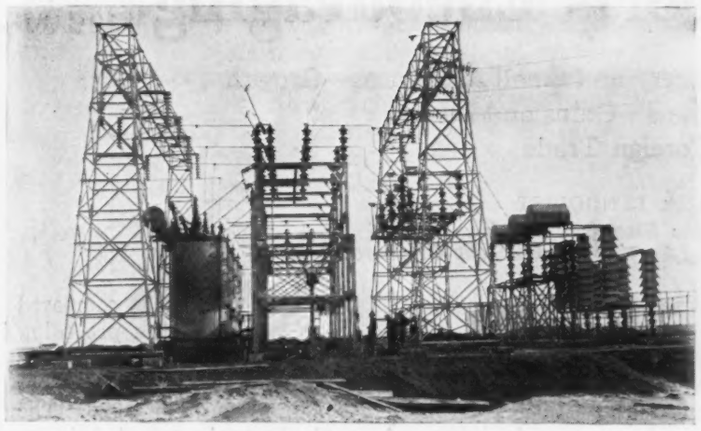
5. Ground wires are used on the majority of existing systems, but the trend in more recent installations is toward the omission of the ground wire.

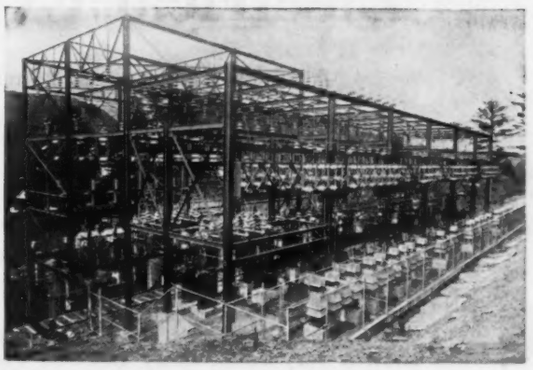
6. Arresters of several types are used on existing systems in the majority of installations, but many lines are in operation at 60 kv. and above which are not equipped with arresters.

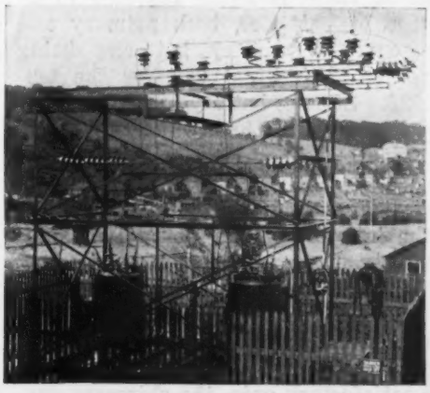
7. The trend in all sections of the country is toward higher voltages, but an examination of recent installations shows that a very great range of voltages is used; for example, 44 kv., 45 kv., 60 kv., 66 kv., 88 kv., 100 kv., 110 kv., 132 kv., 166 kv. and 220 kv. It would seem good practice, in view of future developments in interconnection, to omit several of these voltages from the list for future installations.

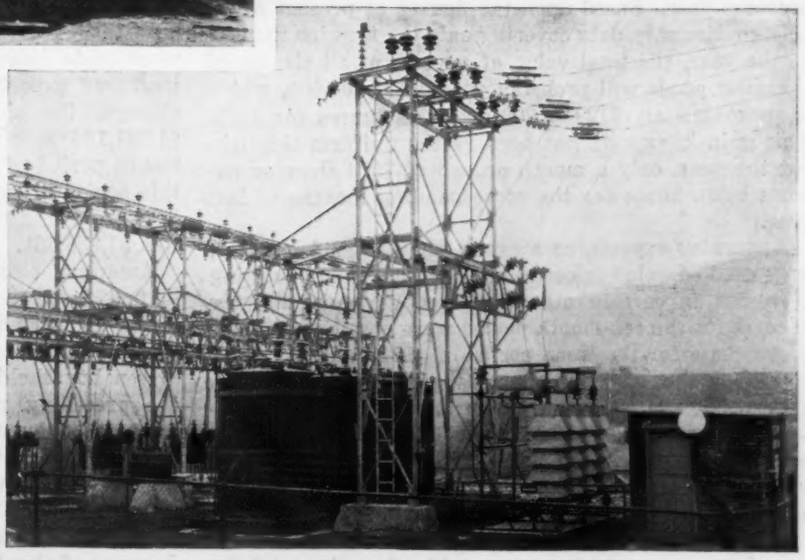
8. There exists little agreement in transmission-line design and installation in this country even in a geographic section, and work to bring closer agreement on many items would seem advisable.

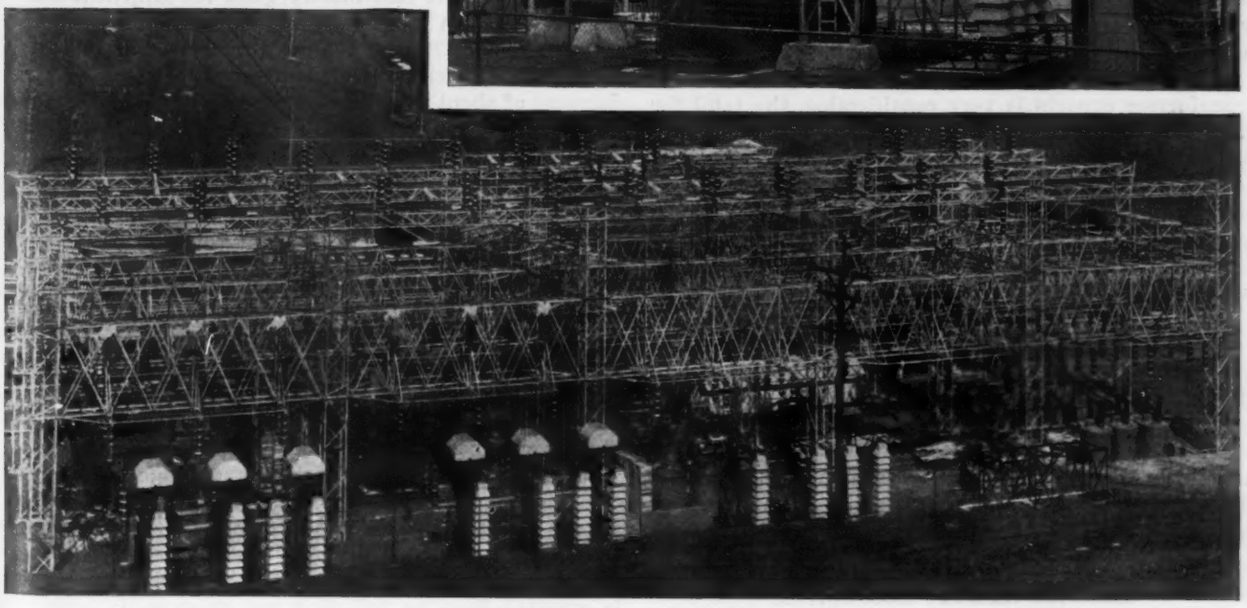
Outdoor Station Developments











OUTDOOR substations and switching stations continue to develop and to be successful. The fabricated-steel structure and the channel structure with suspension support of buses continue to be popular. In some cases unit and separated steel structures, as in the 24,000-volt substation of the East Penn Electric Company at upper left, are used in order to insure isolation. The lower view shows the large Connellsville switching station of the West Penn Power Company. A 22,000-volt customer substation of the Penn Public Service Company is shown at the left center, and at the right center a 44,000-volt substation of the Keystone Power Company, which uses automatic air-break switches only on the high-tension side and oil breakers on the outgoing low-tension or 22,000-volt side. At upper right is a structural channel type substation at Waukegan of the Public Service Company of Northern Illinois for operation at 132,000 volts.

Electrical Exports Encouraging

Analysis of Trend in Machinery and Small Apparatus—Growth in Radio Business—Gains and Losses in Foreign Trade

By R. A. LUNDQUIST
Chief of the Electrical Division
United States Bureau of Foreign and Domestic Commerce

CONTINUING the favorable trend apparent at the end of last year, electrical exports during 1924 will show a very satisfactory increase over the previous year. Based upon the figures at present available, preliminary data covering only the first ten months of the year, the total value of exports of all classes of electrical goods will probably exceed $85,000,000, which is approximately $12,000,000 over the figures for 1923. This gain in exports has been rather uniform throughout the year, only a month or two of 1924 showing exports below those for the corresponding months of last year.

Apparatus exports, as a group, show a good increase, with marked gains in certain items more than offsetting decreases in certain others. Direct-current-generator exports for the ten-month period were possibly $400,000 above those for the same period of 1923, and there was a gain made also in alternating-current generators under 2,000 kva. However, exports of large alternating-current generators during the ten-month period totaled only $1,094,667 as compared with $1,216,517 for the same period of 1923. On the other hand, there was a heavy increase in accessories and parts for generators.

According to the preliminary statistics, the gain in transformer exports is very considerable, the total for this period of 1924 being $5,193,152, as compared with $3,029,022 for the corresponding months of the preceding year. While there is a substantial increase in the power-transformer class, the larger portion of the gain is in distribution transformers, these aggregating $2,138,671 for the ten-month period of 1924 as compared with $615,460 for the same period of last year.

In the motor field there was a slight falling off in exports of fractional-horsepower motors and of stationary motors, but a considerable gain was registered in the railway-motor class, the total for the first ten months of this year being $1,202,274 as against $462,634 for the corresponding period of 1923. Considering all classes of stationary and traction motors together, there was, therefore, a gain recorded. In the rectifier, motor-generator and converter class exports increased from $771,048 to $893,663.

Electric Railway Locomotives

Few new railway electrification contracts of any magnitude being filled by American manufacturers during the present year, exports of electric railway locomotives fell off about 20 per cent or thereabouts. On the other hand, there was almost a 20 per cent increase in the exports of mining and industrial locomotives, though the tendency in that field was apparently toward smaller units than during 1923. Exports of starting and controlling equipment for stationary and railway motors were maintained at about the same level as that of 1923.

For the first ten months of 1924 exports of self-contained lighting units totaled $687,951 as compared with $535,378 for the same period of the preceding year. It is interesting to note that the number of units shipped during the 1924 period was 3,114 as against only 1,955 for the corresponding months of 1923. The world-wide interest in radio is again reflected in an increased exportation of batteries, both primary and storage, the shipments of primary batteries being $1,381,186 as compared with $1,064,978 for the ten-month period of 1923. Storage-battery exports during this period of 1924 totaled $2,432,885, which is a heavy increase over the same period of 1923, when the total was $1,988,561.

American electrical appliances apparently continued to find favor in the international market. Fan shipments show an increase during 1924 of approximately 45 per cent over the 1923 totals, and exports of motor-driven household devices also are greater than during the preceding year, although the increase is small. Exports of domestic heating and cooking devices, however, show a more satisfactory gain, the shipment during the first ten months of 1924 totaling $904,979 as compared with $792,692 for the same period of 1923.

In the electrical communications field there was a decrease of about 30 per cent in the exports of telegraph equipment when comparing the ten-month period of 1924 with that of the preceding year. On the other hand, a net gain was registered in the exportation of telephone equipment, a decrease in magneto telephone exports from $176,030 for the first ten months of 1923 to $153,551 for the same period of this year being more than offset by an increase in the shipment of other telephones from $267,542 for the 1923 period to $484,182 for 1924. Likewise, a decrease in the exports of magneto switchboards from $116,351 for the 1923 period to $13,254 for the present year was handsomely compensated by an increase in the shipment of other telephone switchboards from $332,440 to $1,133,397.

As was to be expected from a knowledge of the increasing interest in radio throughout the world, a heavy gain is registered in the export of radio goods, the total for the first ten months of 1924 being $4,001,753 as against $2,730,978 for the first ten months of 1923. It is expected that the full year will show radio exports reaching a total of $5,000,000.

Incandescent lamp exports were maintained at about the same level as during 1923, only a small falling off being noted. The shipments of flashlight cases show an interesting total for the ten-month period of this year, the figure being $628,883 for that period as compared with $416,020 for the same months of 1923.

Our foreign trade in wiring devices, conduit fittings and electric fixtures continued the increase presaged by the previous year. Exports of conduit, switch boxes, etc., totaled $499,211 for the first ten months of this

year as compared with $387,312 for the same period of last year. Sockets, receptacles and lighting switches totaled $1,087,398 for the ten-month period of 1924 as against $902,133 for the same months of 1923. Electric lighting fixtures and miscellaneous wiring devices show a total of $1,623,696 for the ten-month period of this year in comparison with $1,533,925 for the same period of last year. Insulated copper wire and cable show a very good gain, the value of the exports in this class during the first ten months of this year being $3,337,352, which indicates a very satisfactory increase over last year's total of $2,675,674 for the same number of months.

For the first ten months of this year as compared with 1923 there was a slight increase in electrical porcelain exports, the figures being respectively $1,522,794 and $1,457,679. Bare-copper-wire exports during the ten-month period declined somewhat under last year, being $1,503,402 as against $1,579,855 for 1923.

Miscellaneous electrical export items, such as spark plugs, insulating material and electrical carbons, all show substantial increases, while there is a falling off in the class "other manufactures of aluminum," in which aluminum transmission wire is placed. A decrease is noted in the miscellaneous electrical class, this latter general class declining from $7,157,182 during the ten-month period of 1923 to $6,733,825 for the same period of 1924.

Exports to Neighbors

Of our North American markets Canada, of course, took the largest portion, though there were good gains registered in both Mexico and Cuba. During the first six months of this year exports of electrical goods to Mexico totaled $2,673,246 as against $1,901,748 last year. In the case of Cuba the increase was still greater, the figures for the periods of 1924 and 1923 under consideration being respectively $2,510,410 and $1,626,590. The aggregate of our electrical exports to all North American markets during the first nine months of 1924 was $21,512,683 as compared with $16,843,845 for the same period of 1923.

Our exports to Asiatic countries, totaling $13,551,965 for the first nine months of 1924 as compared with $10,024,445 for the same period of 1923, show a handsome gain over the preceding year. Exports to Japan, of course, account for the bulk of this, the shipments to that country during 1924 running about double what they were last year. China, which ordinarily is the second largest Asiatic market for electrical goods, took only $581,505 worth of these products during the first six months of 1924, whereas during the same months of 1923 the total was $886,302. The decrease in this field can readily be understood when consideration is given to the political uncertainties that have existed in China for some time. Electrical exports to British India show a slight increase for the 1924 period, the preliminary figure for the six-month period of this year being $627,665 as compared with $590,933 for the same period of 1923.

Exports to European Nations

European markets show a slight falling off as compared with 1923, the preliminary figures for the first nine months of this year being $10,372,973 in comparison with $10,828,816 for the equivalent period of last year. Great Britain continued to be our most important customer in the transatlantic field, with electrical appliances one of the most important items of export to that market. The figures for the six-month periods of 1924 and 1923 are respectively $2,942,181 and $2,552,402, showing an increase of about $390,000 in our shipments to that market. France ranks next in importance, having taken $1,539,575 worth of electrical products during the first six months of this year, which is an increase of about $230,000 over last year, the total for that period of 1923 being $1,308,741. Spain during the first half of this year took $1,241,963 worth of American electrical goods in comparison with $1,189,980 during the same period of 1923.

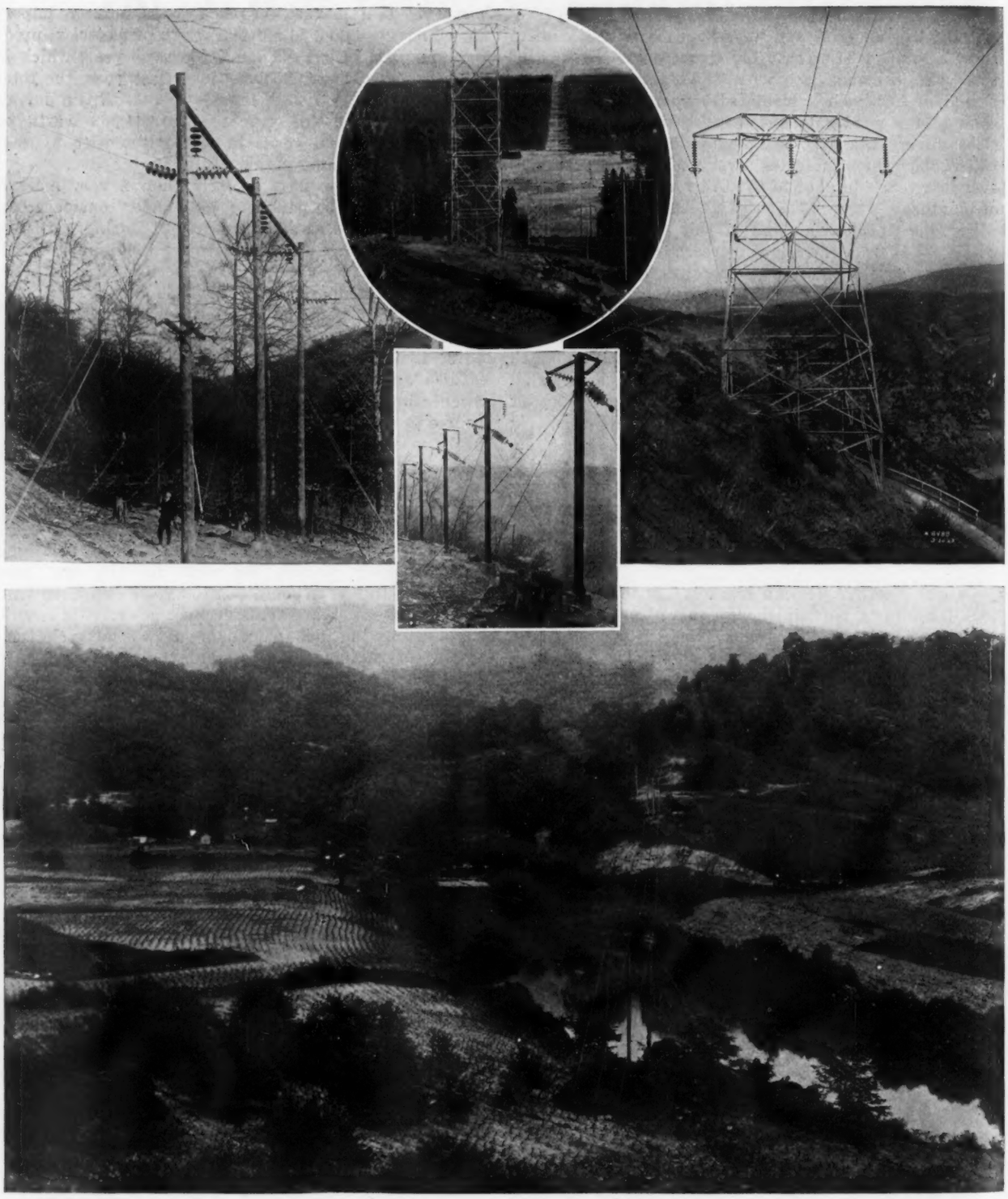
Our electrical exports to Italy show a very marked increase during the period of 1924 under consideration, totaling $874,721 as against $418,521 during 1923. A smaller percentage gain is shown for Belgium, to which market our exports during the period of 1924 were $526,120 as compared with $256,368 during the same period of 1923, and for the Netherlands, to which our electrical exports during the period of 1924 totaled $373,942 as compared with $196,396 during 1923. There is also an increase in our electrical exports to both Sweden and Norway, and this can be ascribed in some degree to radio, that factor being of greater importance in the case of Sweden, where broadcasting is farther advanced.

Decrease in South America

South American markets absorbed considerably less of our electrical products this year than last, according to preliminary figures, the total for the first nine months of this year being $8,876,637 as compared with $10,097,653 last year. This decline, however, is readily explained by the fact that during 1923 a large electrification contract in Chile brought the total exports to that country considerably above the normal amount that might be expected, and the South American total was increased accordingly. As a result, on the basis of the preliminary figures for the nine-month period, South America has dropped from third to fourth position among our world's market. Brazil shows a good increase during the first six months of 1924 and takes first rank among our South American electrical markets. The total of our shipments reached $2,232,644 during the first half of this year as compared with $1,142,046 for last year. Part of this increase is explained by electric locomotive shipments and large apparatus purchases, but there was also a consistent demand for all classes of electrical goods. Argentine shows a decrease from the preceding year, the total for the half year being $1,896,611 as compared with $1,570,263 for this year. Chile, as would naturally be expected, is our third most important market in South America and shows an increase over the preceding year, according to preliminary figures.

The Oceanic markets, comprising mainly Australia and New Zealand, show a total of $5,462,418 for the first nine months of this year in comparison with $4,511,544 for the same period of 1923. Radio was a factor of much importance in both of these markets, though there is a well-balanced export of electrical goods in each instance. African markets, though their total demand is not great, show a good percentage gain over the preceding year, the preliminary figures for the first nine months of this year being $1,425,261 in comparison with $897,776 for the same period of last year. Somewhat better business conditions in British South Africa, which is by far the most important market on that continent, were the underlying cause of the gain in this field.

High-Tension Transmission



INTERCONNECTIONS and extensions of high-tension transmission lines were made and new lines were built in all parts of the country in 1924. A 220,000-volt line in eastern Pennsylvania adds another unit to the very high-tension group and may presage still further developments of this nature on the Atlantic Coast. In the Middle West 132,000-volt lines are being built to connect systems and stations, and in the South, including the Appalachian coal-field region, great activity in building and planning transmission systems prevails, with progress toward interconnection.

In the technical aspects of overhead transmission little development has occurred other than the promotion of better mechanical structures, better inspection methods and tools and more knowledge of corona and other high-tension phenomena. The coming year will be fruitful in the physical growth of lines, and certain researches on dielectrics being conducted by several companies are promising.

High-tension underground cables were of intense interest to many engineers, and another year should witness actual installations at very high voltage. Even now 33,000-volt cables are used in several cities, 66,000-volt cables have been successfully used in Cleveland, and recent tests at 110,000 volts have been made by the Adirondack Light & Power Company.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Hydraulic Accumulation.—A. MAAS. —A promising power storage, giving as high as 60 per cent over-all efficiency of the stored energy, is the hydraulic storage, examples of which have been in successful operation for several years. For this purpose the main generating set is directly coupled with a high-pressure water pump. During periods of low electric power demand the surplus energy of the water-wheel is utilized to drive not only the main generator but also the pump, which lifts part of the tailrace water to an elevated reservoir. During peak-load hours the pump is disconnected from the generating set, and the stored-up water is then utilized in an auxiliary turbine-generator set, which may operate in parallel with the main generator, thus covering the peak load. This fundamental method, together with several possible hydraulic and lectric variations, is explained in an elaborate article, which gives descriptions of four actual hydro-electric plants in Europe, with ratings of 300 hp., 800 hp., 2,200 hp. and 55,000 hp. respectively. Of particular interest is the large station last named. It contains two Pelton wheel sets, each comprising on one shaft a 27,500-hp. turbine, a 20,000-kva. three-phase generator and two geared 5,000-hp. centrifugal high-pressure pumps. Designed for a head of 357 meters, each turbine has three runners and two jets per runner, giving a normal speed of 500 r.p.m. Between the generator and the one-to-two gearing is a magnetic coupling which permits connection or disconnection of the pumps at full speed. This coupling is the largest of its kind in existence.—*Zeitschrift des Vereines Deutscher Ingenieure,* Nov. 8 and Nov. 15, 1924.

Working Costs for Heavy-Oil Engine.—Items are quoted from a Diesel Engine Association report giving actual working costs for thirty-four Diesel or semi-Diesel installations in the United Kingdom and three overseas. The total engine cost of the former, with an output of more than 26,000,000 kw-hr. at an average annual plant load factor of 13.3 per cent, was 1.82 cents per kilowatt-hour; for the others, with 8,000,000 kw.-hr., 1.36 cents. The conditions in many instances were unfavorable. The maintenance cost appears to be in the neighborhood of £1 per kilowatt installed, based on data for 112 engines totaling 22,000 kw.—*Electrician (England),* Nov. 21, 1924.

Economic Design of Penstocks.—H. L. DOOLITTLE. — Proceeding from a premise essentially analogous with Kelvin's law for electrical conductors—namely, that the most economical penstock will be that in which the sum of the annual value of the power lost in friction and the annual charges for interest, depreciation, taxes, etc., is a minimum—the author has devised a graphical method. This is described and an illustrative example is worked out numerically. As a final step a curve is plotted for each diameter considered, with distances from the starting point as abscissas and annual costs per foot as ordinates. The area under each curve then represents the total annual cost for a pipe of given diameter and material. In the discussion following the paper R. L. Daugherty gives an algebraic method for solving the same kind of problem. — *Mechanical Engineering,* Mid-November, 1924.

Generation, Control, Switching and Protection

Alignment Charts for Piping Problems. — LOUIS E. PATSCH. — Several charts of the straight-line or monogram type are given for the rapid solution of problems involving pipe sizes and lengths and steam flow in terms of velocity, volume, weight, density and pressure drop. Their use is explained in several practical examples.—*Power Plant Engineering,* Dec. 1, 1924.

Current-Limiting Switch.—M. JORGENSEN. — Cheap hydro-electric power made it possible to supply 80 per cent of the consumers in Norway on a flat-rate basis. To prevent users taking more than the energy contracted for, a limiter has been installed at every customer's plant which automatically interrupts the service when the stipulated supply is exceeded, but connects it again when the loads drop below the maximum demand agreed upon. To avoid unjustified interruptions and to insure perfect performance, a great many of these limiting switches of various manufacture were subjected to rigorous tests. These were withstood best by the design by Jacobsen described in this paper. Its principle involves the combination of a calibrated electromagnetic relay with an expanding hot wire. At excessive current the relay closes and energizes a small transformer. The secondary of this transformer heats a metal strip, the bending of which interrupts the line. A momentary overload is thus of no consequence. If the overload persists, the apparatus makes and breaks the line about ten times per minute. A life test to which it was subjected, comprising a million operations, did not seem to affect the contacts on a 5-amp., 220-volt limit switch. Although the switch is adjustable up to 35 amp., three models, for 0.2 to 1 amp., 1 to 3.75 amp. and 2 to 10 amp. have been standardized. — *Revue Générale de l'Électricité,* Nov. 29, 1924.

Oil-Circuit-Breaker. — M. F. OERLIKON.—The sudden pressure generated by an electric arc under oil and the great possibility of the ignition of gases thus developed are the two most difficult problems against which the designer of oil switches has to guard. The present descriptive paper shows how a Swiss concern attempts to overcome these electromechanical details. The contacts themselves are inclosed in a strongly built gas chamber which has a number of small openings acting as baffles upon the escaping gases. The main contact is of the plunger type, fitting snugly into a multisector stationary copper ring. Concentrically around the contacting device are arranged a number of insulating cylinders, upon the surface of which the resistance wire for the intermediate contacts is wound. It is claimed that this is the most logical place for this resistance, because it is least liable to be affected by the settling of soot from the oil, as is the case, for example, on all designs where this resistance is lodged at the bottom of the oil tank. A double position indicator makes it possible at all times to see at a glance the exact position of the switch contacts. Universal joints between contacts and inclined high-voltage leads simplify greatly a proper alignment of the switches in the tank. These new switches can be equipped with an internally located overload tripping mechanism. Illustrations show models and their details for installations up to 80 kv.—*Bulletin Oerlikon,* November, 1924.

Transmission, Substations and Distribution

Methods for Increasing the Power Factor in Distribution Systems. — R. LILJEBLAD.—This paper gives a general discussion of the different methods available for improving the power factor in distribution systems. The discussion applies to Swedish conditions, where the induction motor with short-circuited rotor is not widely used. The author emphasizes the importance of this means of improving the power factor. — *Teknisk Tidskrift (Sweden), Elektroteknik,* Nov. 1, 1924.

Operating Characteristics of Rural Transmission Lines.—The engineering extension department of Iowa State College has been collecting information relative to electric service given by rural transmission lines. This covers a period since 1919. During the past year and a half additional data showing power factor, maximum demand, amperes, volts and losses on these lines have been gathered, and this information is recorded in this bulletin.—*Bulletin No. 53, Engineering Extension Department, Iowa State College.*

Swiss Outdoor Substations. — E. HEUSSER. — Outdoor installation of large power apparatus seems to be slowly gaining ground in Europe. Notably in Switzerland a number of such plants are now in successful operation, among which the Olten substation of the Federal Swiss Railways is the largest not only in that country but in all Europe as well. The plant contains five single-phase, 3,000 kva. self-cooled transformers, which step the incoming 60,000-volt, single-phase current down to 15,000-volt railway trolley voltage at a frequency of 16⅔ cycles. The complete equipment of the station, including choke coils, switches, lightning arresters and measuring transformers for both the high-voltage and low-voltage sides, are made to stand outdoor installation. All switches have electric remote control, operated from a centrally located control room. The main oil switches have a rated interrupting capacity of 250,000 kva., but are capable of opening a short circuit of 600,000 kva. There are ten breaking points in each switch, so arranged with protec-

tive resistances as to give a gradual opening and closing (multi-resistance step switch). All 60-kv. insulators are tested with 200 kv. and all 15-kv. insulators with 65 kv. Exterior high-voltage wiring of the station is executed in copper tubing with concentric screw joints.—*Elektrotechnik und Maschinenbau*, Nov. 2, 1924.

Units, Measurements and Instruments

Temperature Indicator Tester. — D. LEWIS. — An instrument is described which provides a simple and rapid method of checking the accuracy of temperature indicators or recorders in use with thermocouples. It is shown, theoretically, that the instrument is electrically equivalent to a thermocouple which can be made to generate any required electromotive force (in millivolt steps) and have any required resistance between 1.2 ohms and 12.2 ohms. Details are given on how to use the instrument.—*Journal of Scientific Instruments (England)*, November, 1924.

Curve Drawing Apparatus for Vacuum Tubes.—H. STAHL.—The characteristics of a vacuum tube such as is used in radio work are best expressed by furnishing with the tube a curve sheet of the various electrical data of the particular tube. When there is a variation of the voltage on the grid, the heating, the anode voltage, the anode resistance, and in some cases the voltage on the auxilliary grid, will vary correspondingly. These characteristic curves have hitherto been plotted by hand from a great number of individual readings. The author has devised for this purpose a semi-automatic apparatus, with the aid of which they can be plotted mechanically by unskilled operators in a routine way. The apparatus consists of a slide-contact resistance so arranged that a movable drawing board is rigidly connected with the slider. By turning a small hand wheel, which operates a threaded spindle, the slider is moved along the resistance and at the same time the drawing board, upon which has been fastened a sheet of co-ordinate paper, is moved forward. Above the drawing board a mirror is placed which reflects the beam from a galvanometer down upon the board. While the resistance varies the voltage, the galvanometer measures the other variable sought, and the light spot upon the moving board gives the relation of the two. All the operator has to do is to turn the hand wheel with his left hand and trace with a pencil in his right hand the traveling light spot upon the board. —*Elektrotechnische Zeitschrift*, Nov. 27, 1924.

Motors and Control

Electrification of Roumanian Oil Fields.—A. PROCA.—Soon after the first few trial installations of electric drive for drilling towers, pumps and other machinery in the oil fields of Roumania, the great advantages of this general electrification became quickly apparent, and with plenty of cheap power available its progress is now very rapid. Three-phase current of 25 kv. and of 10 kv. at 50 cycles is being furnished, which is transformed to 500 volts for power and to 110 volts for lighting. Percussive and rotary drilling are common, with the present tendency toward more general use of the latter method. For drives with constant speed squirrel-cage motors with a starting compensator and frequently with a centrifugally operated mechanical clutch are the rule. Variable speed is obtained from wound-armature motors and step resistances. To prevent fire danger all collector rings are totally inclosed and usually installed outside of the motor bearing. Likewise all starters and other switches are totally inclosed or oil-immersed. Starting compensators are built in one unit with the operating controller switch in one oil tank Apparently only apparatus of German and Austrian manufacture is installed in these fields.—*Revue Générale de l'Électricité*, Nov. 29, 1924.

Heat Applications and Material Handling

Ferrophosphorus from the Electric Furnace. — THEODORE SWANN. — The sources of raw material, the reason for the demand and important considerations in the manufacture of ferrophosphorus are given. The electric furnace operates at about a 94 per cent power factor and a 90 per cent load factor may with care be obtained. The electrode consumption is small, around 5 lb. per 1,000 kw.-hr. input.—*Iron Age*, Dec. 4, 1924.

Industrial Electric Heating Installations.—This is a serial report of the industrial heating committee of the N. E. L. A. Realizing the small amount of data on industrial heating installations available for general distribution, the committee began the compilation of data from installations in the territory of its members. With the aid of a questionnaire, the reports on the various installations have been standardized and are published in a form suitable for ready reference. In all forty-eight installations are covered. — *Publication No. 24-80 of the N. E. L. A.*

Traction

Electric Road Vehicle.—D. E. BATTY. —In this long and apparently full abstract of a paper read before the Institution of Automobile Engineers (England) the operating characteristics of the electric and gasoline vehicle are first contrasted. Tractive-effort curves for a trolley bus and a four-speed gasoline bus of equal weight show higher values for the former, especially at the lower speed. An analysis of one bus gives, for performance on the level, the figures reproduced in the table. The author expresses the belief that the trolley bus may go far toward solving the problem of replacing worn rails. He then describes several gasoline-electric systems, both full electrical and electromechanical, that have been devised for transmission.—*Engineering (England)*, Nov. 14 and 21, 1924.

PERFORMANCE OF ELECTRIC ROAD VEHICLE

Gear Ratio	Miles per Hour	Units per Car-Mile	Watt-Hours per Ton-Mile	Efficiency, Per Cent	Road Resistance Lb. per Ton	
11.66	14.8	0.91	130	74	48	full field
9.66	17.0	0.91	130	76	49.4	
11.66	16.6	0.904	129	76	49	shunted field
9.66	19.0	0.894	128	78	50.5	

Telegraphy, Telephony, Radio and Signals

Damped Oscillations Produced by Triode Valve.—Y. WATANABE.—When a valve oscillator is so arranged as to produce sustained oscillations, damp oscillations are very often obtained. The reason for this action is explained. The author has studied the case, using grid voltages of comparatively low frequency (50 cycles) and a higher frequency (about 10,000 cycles), and has experimentally determined the critical frequency, the critical magnitude of the grid voltage and the critical filament current which is necessary for the production of the damped oscillation.—*Journal of the Institute of Electrical Engineers of Japan, No.* 434.

Effect of the Shape of the Transmitting Aërial Upon Observed Bearings on a Radio Direction-Finder. — R. I. SMITH - ROSE. — The experiments described in this paper were carried out to determine to what extent the emission of abnormally polarized waves by aërials of different shapes from a ground transmitting station was responsible for the frequent occurrence of variable "night errors" at a ground direction - finding station. Diagrams are given and the summarized results are tabulated. It is concluded that the frequency and magnitude of these errors are independent of the shape of the transmitting aërial, within the limits of this investigation, and that the use of a source of radiation which is as far as possible only polarized in the normal manner in no way diminishes the night effects generally experienced.—*Journal of Institution of Electrical Engineers (England)*, November, 1924.

Electrical Constants of Dielectrics for Radio Frequency Currents.—R. V. GUTHRIE, JR.—The method and apparatus used are described and illustrated, followed by a table of dielectric constants and power factor, at 10^6 cycles per second for thirty-nine substances.—*Proceedings of Institute of Radio Engineers*, December, 1924.

Miscellaneous

Vibration Problem in Engineering.—C. R. SODERBERG.—The author investigates in this section of a continued article the influence of the stationary parts of electric machines upon the critical speed of the rotating members. The treatment, while mathematical, includes a running commentary on the physical significance of the equations. The conclusion is that the critical speed of the rotating part is lowered by (1) flexibility of the bearing pedestals and their supports, (2) the parts of the masses of these members, which enter into the vibrating motion, and (3) the magnetic pull in the air gap. These have an influence that may in extreme cases amount to 20 or 25 per cent. This reduction is of greatest importance in relatively low-speed machines operating slightly below the fundamental critical speed. — *Electric Journal*, December, 1924.

News of the Industry

Investigation of "Power Trust" Now Asked

Senator Norris Fathers a Resolution with That Object—Another Senator Assails "Fertilizer Trust," and Muscle Shoals Blockade Remains Unbroken

FRUITLESS wrangling once more marked the Senate debate on Muscle Shoals, the "unfinished business" of the Upper House, when Congress reassembled after the Christmas holidays. A resolution directing the Federal Trade Commission to investigate and report on the ramifications of an alleged "power trust" was introduced by Senator Norris of Nebraska. Action was deferred.

The resolution recited that "it has been alleged on the floor of the Senate and in the public press that a power trust exists in the United States and that many public utility and power companies are wholly or partly controlled through stock ownership, interlocking directorates and various other means and methods by various combinations of water-power companies, large manufacturing and industrial corporations and by banking and other institutions." The commission, under the resolution, was directed to investigate "the present degree of concentration and interrelation in the ownership, control, direction, financing and management through legal or equitable ownership of stocks, bonds or other securities or instrumentalities, or through interlocking directorates or holding companies, including trade associations, or through any other device or means whatsoever, of power companies, transmission companies, public utility companies and other companies and associations engaged in what is commonly known as the public utility field of business."

The resolution also seeks information relative to the extent to which banks and trust companies and the principal companies manufacturing electrical equipment and apparatus have an interest in public utility companies.

Senator Norris said on Tuesday that the withdrawal of the General Electric Company from public utility ownership, just announced, would not deter him from pushing his resolution. Asked in New York whether the proposed investigation at Washington had anything to do with the General Electric Company's new move, President Gerard Swope declared that the change had been under consideration for more than two years.

Assails "Fertilizer Trust"

Senator Harrison of Mississippi declared the resolution should be amended to include an investigation of the "fertilizer trust," which, he said, was opposed to the Underwood bill. He read a published statement by Gustavus Ober, Jr., of Baltimore, president of the National Fertilizer Association, which Senator Harrison said was the "fertilizer trust," in which Mr. Ober declared the Underwood bill would demoralize the fertilizer industry. The Mississippi Senator declared that Ober was opposed to either private or government operation of the nitrate plants at Muscle Shoals for the production of fertilizer for the farmers.

Senator Bruce of Maryland came to Mr. Ober's defense, and an acrimonious passage at arms followed.

The opinion is freely expressed in Senate circles that the Underwood measure is beaten, and that the amendment of Senator Jones of Washington, under which an investigation would be made by a commission, will be adopted.

Weeks Says Royalty on Nitrate Patents Is Too High

The possibility that some disposition may be made of Muscle Shoals at this session of Congress has prompted the Secretary of War to request authorization to spend $15,000 for the defraying of such expenses as may be necessary in connection with the arbitration of the rate of royalty to be paid the American Cyanamid Company for the use of its patents at Nitrate Plant No. 2. The contract between the government and the American Cyanamid Company provides for the payment of royalty at the rate of 1½ cents per pound of fixed nitrogen. Were nitrogen to be fixed at the rate of 40,000 tons per year, it would be necessary at that rate to pay the Cyanamid Company $1,200,000 per year. The contract runs until 1934.

Secretary Weeks contends that there is every reason why the royalty rate should be reduced. Moreover, he argues that the present rate is so high as to be prohibitive of an economical production of fixed nitrogen at that plant.

Joliet and Quincy Utilities Sold to Middle West

Van Horn Ely, president of the American Electric Power Company, Philadelphia, has announced the sale to the Middle West Utilities Company of Chicago, of which Martin J. Insull is president, of the Chicago & Joliet Electric Railway Company, which supplies light and power in Joliet and neighboring towns in addition to operating local and suburban railways, and the Quincy (Ill.) Gas, Electric & Heating Company, reaching a population of 40,000 with electric service. The deal included also gas companies in Warsaw and Goshen, Ind., and Niles, Mich. The total consideration was not announced by Mr. Ely, but it is believed to have been approximately $10,000,000.

Will Spend $41,500,000

North American Company Publishes Outline of 1925 Budget for Three States

APPROXIMATELY $41,500,000 will, according to President F. L. Dame, be expended by the North American Company during the coming year for new construction work and for other developments of the physical properties of the company's subsidiaries in and around Cleveland, St. Louis and Milwaukee. Plans for the northern Ohio district surrounding Cleveland call for the expenditure of approximately $20,000,000. In the Illinois-Missouri territory, centering in St. Louis, the expenditures for additions and extensions will aggregate approximately $11,000,000, and for the construction plans in Wisconsin and Michigan expenditures of approximately $10,000,000 will be made. Electric and coal properties in Kentucky will be improved at a cost of approximately $500,000. The largest single undertaking will be the 400,000-hp. station to be built at Avon, near Cleveland, to supplement the facilities of the Cleveland plant, as already related in the ELECTRICAL WORLD.

To Erect Commemorative Tablet at Niagara Falls

Today (Saturday, January 3) a bronze tablet is to be unveiled at the portal entrance to Power House No. 1 of the Niagara Falls Power Company at Niagara Falls, N. Y. This tablet, which is the gift of Edward D. Adams of New York, veteran engineer and financier and former president of the company just named, will commemorate "the pioneers of the Niagara Falls Power Company of 1886." It will be dedicated with appropriate ceremonies.

New York Water Power Board Denies All Applications

The outgoing Democratic New York State Water Power Commission at its final meeting at Albany on Monday denied applications for the development of approximately 1,000,000 hp. in the St. Lawrence River by the Louisville Power Corporation and the St. Lawrence Transmission Company. The commission at a previous meeting in September denied all pending applications for development of power by private corporations with the exception of these two companies. The original

Applications in both instances were made during the Miller administration after the enactment of the Robinson law. Preliminary licenses to make surveys had been granted in some instances, but further action was suspended when Governor Smith took office January 1, 1923.

The incoming Water Power Commission, which is composed of the Conservation Commissioner, State Engineer and Surveyor, Attorney General, Temporary President of the Senate and Speaker of the Assembly, will be completely Republican, and while able to function with unanimous accord under the Robinson law, will be handicapped in consideration of the applications made under it owing to the action of the outgoing commission.

Portland (Ore.) Girl Wins Capital Prize

Model Electric Home in Better-Home-Lighting Contest Goes to Julia Groo—Ten Scholarships, Worth from $300 to $1,200, Are Widely Distributed

COMPETING with more than two million school children in the United States and Canada, of whom nearly one million actually submitted essays, fairy tales and verses in the better-home-lighting contest, Julia Groo, 87 North Twenty-third Street, Portland, Ore., eighteen years of age, was declared the winner of the fifteen-thousand-dollar model electric home offered by the Lighting Educational Committee, 680 Fifth Avenue, New York City. This home will be built on a lot provided by Miss Groo anywhere she desires. Ten other boys and girls in various portions of the United States and Canada received scholarships ranging in value from $300 to $1,200.

The international judges of the home-lighting contest were William McAndrew, superintendent of schools, Chicago; Mrs. William Brown Meloney, editor the *Delineator;* B. C. Forbes, editor *Forbes Magazine;* Sarah L. Rhodes, principal Public School 28, Brooklyn; George D. Shepardson, professor of electrical engineering, University of Minnesota; George R. Anderson, professor of illuminating engineering, University of Toronto, and M. H. Aylesworth, executive manager of the National Electric Light Association, who acted for Franklin T. Griffith, president of that association, Mr. Griffith being unable to be present. The judges selected the winning essays from over 45,000 local prize winners in 4,784 communities in the United States and Canada. Each community was allowed to submit ten to fifty local winners for the judges' consideration, according to its population.

With the use of a "Home-Lighting Primer" containing lessons on home lighting, the contestants were obliged to do three things in the competition: First, to make an investigation of their own and two neighbors' homes and report in the primer on the lighting conditions there found; second, to cut fixtures from a catalog in the primer and paste them in what they thought were the proper places in the "lightless" illustrations of rooms also contained in the primer; third, to write an essay explaining how they would change the lighting equipment in their own homes to conform with present-day lighting standards. Miss Groo was adjudged the winner because she complied most rigidly with the rules of the contest and presented an essay which was clear, well written and of superior excellence.

The five boys and five girls who won scholarships are as follows:

Two second prizes of scholarships worth $1,200 in American or Canadian colleges: George R. Pinaroc, 451 Elwood Avenue, Oakland, Cal., and Dorothy Lathe, East Aylmer, Quebec, Canada.

Two third prizes of scholarships worth $600 in American or Canadian colleges: John P. Crawford, 1226 West Walnut Street, Kokomo, Ind., and Lucile Brewer, Gainesville, Ga.

Two fourth prizes of scholarships worth $600 in American or Canadian colleges: Joe Kelly, 839 East Washington Street, Martinsville, Ind., and Irene Kline, 274 State Street, Lowville, N. Y.

Two fifth prizes of scholarships worth $300 in American or Canadian colleges: Roswell E. Brett, 937 Gotham Street, Watertown, N. Y., and Mary W. Holman, Huntsville, Mo.

Two sixth prizes of scholarships worth $300 in American or Canadian colleges: Everett E. Wigger, 40 North Main Street, West Alexandria, Ohio, and Eleanor K. Linik, 58 Aurora Street, Lancaster, N. Y.

Hughes Praises Influence of Science—Metric Men Meet

To science as a peacemaking force among the nations high praise was accorded by Secretary of State Hughes in welcoming the members of the American Association for the Advancement of Science to Washington for their annual meeting last Monday. Because of the high degree to which international co-operation has been advanced among scientists, their attitude, the Secretary said, might be taken as a model for the attitude of individuals desiring to show an "enlightened patriotism" and by nations seeking advancement in peace. "If civilization," he declared, "is to advance it will be your doing, and the best we can hope of governments is that it will not stand too much in your way."

Simultaneously with the Association for the Advancement of Science the Metric Association held its annual meeting. On the program were many prominent technicians. One of the features was the group luncheons. At these luncheons manufacturers discussed their metrological problems with Dr. Carl Hering of Philadelphia, scientists theirs with Dr. Alexander McAdie of Harvard University, educators theirs with Dr. A. E. Kennelly of Harvard, and physicians, chemists and dietitians theirs with Prof. E. C. Bingham of Lafayette College, Easton, Pa.

Susquehanna Power Company Asks License

Federal Commission Soon to Pass Upon It—Interstate and Intercorporate Complications

BECAUSE of the desire of the Susquehanna Power Company of Bel Air, Md., to proceed as rapidly as possible with its project on the Susquehanna River a meeting of the Federal Power Commission is to be held soon after the first of the year to pass on the company's application for a license. The project contemplates the erection of a dam with a crest elevation of 103 ft. above the sea level which will create slack water for a distance of 10 miles to the tailrace of the existing Holtwood plant. The power is to be sold to the Philadelphia Electric Company.

Owing to the cost of relocating the Columbia-Port Deposit Railroad on the east bank of the Susquehanna, it is not regarded at this time as being economically feasible to develop the full head in the initial installation. It is pointed out, however, that the entire head can be developed later if the demand for power warrants it.

In view of the fact that the project has been in process of organization for a period of years and expenditures have been made by several interests, and since the Susquehanna Power Company acquired lands and other properties through the issuance of capital stock, the accountants of the commission have been unable to determine costs in terms of money. For that reason it is expected that the commission will require as a condition of the license that the actual cost be fixed jointly by the Federal Power Commission and the public service commissions of Maryland and Pennsylvania.

COMPLICATED RELATIONS

The dam and the power house will be in Maryland. In fact, 90 per cent of the investment will be in that state. A portion of the flooded lands and the main transmission line will be virtually the only properties in Pennsylvania. The financing of the project, however, is to be undertaken by the Susquehanna Water Power Company of Harrisburg. On completion it is the present intention to lease the properties to an operating corporation. It is this third corporation which will contract with the Philadelphia Electric Company for the power. From the investigation made by the Federal Power Commission it appears that this sale would not be subject to regulation by the public service commission of either state. There also is doubt as to whether the Pennsylvania commission would have a right to review the issuance of the proposed securities. For that reason it is probable that the Federal Power Commission will withhold the issuance of the license until copies of the lease and of the contract have been filed. On account of the complicated intercorporate relations it is probable that the commission will require that the issuance of securities for the financing of the development be subject to its approval.

Washington Rates Down

Potomac Company Agrees to 25 per Cent Reduction and a Substantial Refund

A BATTLE over electric rates which has lasted seven years and involved much litigation was settled out of court this week when the Potomac Electric Power Company, which supplies light and power to the national capital, agreed to reduce its rates at once by 25 per cent and to refund to consumers half of the $6,000,000 which has been impounded under court decree and represents the difference between the rate of 10 cents per kilowatt-hour collected by the company and the 7.67-cent rate ordered by the Public Utilities Commission of the District of Columbia in 1917. The new rate will be 7½ cents a kilowatt-hour. The company's customers, besides gaining far cheaper rates for the future, will receive back approximately 10 per cent of the payments they have made since the impounding order went into effect. The company, on the other hand, while conceding the heavy cut in rates, saves a large sum through the reduction being made only in part retroactive.

Agreement on the valuation of the company's property has also been reached, it being put at $32,500,000.

Springfield, Mass., Gets Good Rate Decrease

A 5½ per cent reduction in household lighting rates, effective January 15, 1925, was announced just before Christmas by the United Electric Light Company, Springfield, Mass., in a display advertisement, which called attention to the reduction as representing a present of $80,000 to the public. The new rate will be 8½ cents per kilowatt-hour and is made possible, according to L. J. Scott, manager of the company, by slightly lower fuel costs and economies in operation.

Byllesby Company May Control Duquesne Light

Reports printed in the daily press and which appear to have some basis point to a possibility that the Duquesne Light Company of Pittsburgh will soon be absorbed by the Byllesby interests. This will come about, if at all, through the acquirement of a controlling interest in the United Railways Investment Company by the Standard Power & Light Corporation, which was recently organized by the Byllesby interests to acquire stocks in public utility companies. The United Railways Investment Company controls the Pittsburgh Utilities Corporation, which in turn controls the Philadelphia Company, and the last-named organization owns all the common stock of the Duquesne Lighting Company. The five steps in the chain of control would make the transaction an unusually intricate one.

A number of street-railway, gas and other utility concerns are controlled by the Philadelphia Company, but the Duquesne Light is the only central-station company involved. Its acquisition, if it shall be consummated, will mark the first expansion of the Byllesby interests into the Eastern light and power field, their operating companies hitherto having been confined to Middle West, Southern and Pacific Coast territory.

Illuminating the National Christmas Tree

A permanent location for the national community Christmas tree at Washington, which was told about in the ELECTRICAL WORLD for December 13, page 1275, was assigned by Lieut.-Col. C. O. Sherrill, officer in charge of public buildings and grounds, on Sherman Square, immediately adjoining the White House grounds. Service was brought to the tree with a special cable 1,100 ft. long, and a concrete manhole was constructed adjoining the tree. The equipment for the tree has been presented to Colonel Sherrill, who will act as its custodian. This equipment includes streamers and a complete outfit of 25-watt amber, red and green, spray-finish electric lamps. The Electric League of Washington, with T. Lincoln Townsend as the chairman, assisted by C. M. Marsh of the Potomac Electric Power Company, L. T. Souder, R. P. Harrington, George Mangan, Potomac Electric Power Company, and George Colbeck, took charge of decorating the tree. The two street-car companies in the District carried posters announcing that the President would light the tree. Last year he turned the switch illuminating a felled tree from Vermont. This year a live tree from Amawalk, N. Y., presented through the American Forestry Association, was planted as a permanent object.

National Photo.

PRESIDENT COOLIDGE ACCEPTS THE NATION'S TREE

Left to right—President Coolidge, Mrs. Coolidge, F. M. Feiker, L. T. Souder, Paul Wooton, Col. C. O. Sherrill.

A bronze tablet will be installed as soon as the frost is out of the ground, and on it the part taken in the institution of the tree by the Society for Electrical Development will be acknowledged. The switch used by the President, inscribed "Calvin Coolidge, National Christmas Tree, 1924," was presented by Mr. Townsend to F. M. Feiker, vice-president of the society.

Brooklyn Edison Cuts Rate

Reduction from 8 Cents to 7½ Cents Will Save $1,000,000 a Year to Consumers

A MILLION dollars annually will be saved to the customers of the Brooklyn Edison Company, as estimated on present consumption figures, by a voluntary reduction of the residential lighting rate from 8 cents a kilowatt-hour to 7½ cents. This reduction went into effect on Thursday, January 1. It applies to the whole borough, including Flatbush, where the Edison company had already reduced the rates charged by the Flatbush Gas Company, whose electrical department it recently purchased, from 10 cents to 8 cents a kilowatt-hour.

These are the first reductions in electrical rates made by a New York City central-station company since the war. In announcing them M. S. Sloan, president of the Brooklyn Edison Company, said that it had been the fixed policy of the company to share voluntarily with its customers every benefit that accrued to it, and that the operation of the company's new Hudson Avenue power station and notable changes in the distribution system had reduced the cost of furnishing electrical energy to customers. The new station provides more than half of the energy required for serving the company's 500,000 customers. It has enabled the company to reduce the manufactured costs of energy, which represent about 10 to 15 per cent of the total cost of electric service.

To increase the efficiency of operation, for the last four years the company has been gradually rebuilding its distribution system, changing from two-phase to three-phase and raising the voltage on the transmission cables from 13,800 volts to 27,600 volts. This work is now complete in large measure.

KEEPS UP WITH CITY GROWTH

"Following the policy of the company, we have taken these savings into account and shared them with our customers," said Mr. Sloan. "The Brooklyn Edison Company or its predecessors have been engaged for approximately forty years in serving the public with electrical energy, having spent upward of $110,000,000. In the last five years we expended in excess of $75,000,000, or an average of $1,250,000 per month. We have kept up with and taken care of our share of the growth of this community, which is growing more rapidly than any other part of this country."

William A. Prendergast, chairman of the New York Public Service Commission, issued a statement commending the action of the company in voluntarily reducing rates and promoting good public relations. He pointed out that the saving had been brought about without a rate case or a dollar's cost to company or public. Corporation Counsel Nicholson of New York City, on the other hand, attributed the reduction to fear of proceedings to be taken by the city and declared it "a mere bagatelle to the public and only a small part of the actual reduction that it is entitled to."

Work on Hetch Hetchy Is to Be Resumed After Shutdown

After a three weeks' shutdown on portions of the construction work on the Hetch Hetchy municipal water and power project of the city of San Francisco work is again to be resumed. The shutdown, which was accompanied by much dispute and acrimony among the city authorities, as well as by court proceedings, was due to the depletion of the forty-five-million-dollar bond issue of 1910. The controversy started late in November, when Acting Mayor McLeran ordered work affecting about half of the thousand men employed on the project stopped.

City Engineer O'Shaughnessy and some of the members of the Board of Supervisors held that there was $1,200,000 in the Hetch Hetchy operating fund, derived from the sale of power from a small temporary plant and revenue from the city's railroad, that should be transferred to the construction fund. After failure to transfer these funds or to find some other means of financing the continuation of the work, the Spring Valley Water Company, a private utility supplying water to San Francisco, offered to provide $1,000,000 in cash, as an advance on the rental to become due to the city, under a contract privileging the water company to use the city's aqueduct across the lower end of San Francisco Bay.

This offer was duly accepted, and work was ordered resumed on December 22. The stop order did not affect work on the Moccasin Creek power house nor work on the transmission line, but did delay work on the lining of the tunnel and at the intake. The power end of the project is scheduled for completion early in the spring of 1925.

Four Mayors Confer Over State-Owned Power

A conference of the mayors of Albany, Troy, Schenectady and Cohoes, N. Y., was held with State Engineer and Surveyor Dwight B. La Du last week to discuss the practicability of the use by these cities of electrical energy generated by the state-owned plants at Crescent Dam and Vischer's Ferry on the canalized Mohawk River. The law under which the two-million-dollar hydro-electric plant of the state was erected provides that the energy generated may be sold only to municipalities. As a result of the conference the mayors of the cities named will ascertain what electricity is costing now for municipal purposes and the length of time present contracts have to run, and after learning from the state what price will be fixed for the energy generated at Crescent Dam and Vischer's Ferry, the cities will be in a position to say whether they can make advantageous use of it. At the conference, so far as could be learned, no amendments were suggested to the law to make the sale of the electrical energy possible to private corporations. The primary object of the conference was, of course, to disprove the charge recently made in the public press that the state has a "white elephant" on its hands, inasmuch as the cities of the capital district are unable to distribute or use the electricity. The state will face a heavy financial loss if it is unable to sell this power.

Farm-Service Movement Starts in New England

Electric utilities, agricultural interests and educational institutions in New England are initiating a co-operative investigation of the economic possibilities and service opportunities of electricity on the farm which promises much for future good relations between rural communities and central stations and which is in close accord with the N. E. L. A. work in this field in other parts of the country. The New England movement had its inception in New Hampshire, when former Governor Bass and President Hetzel of the University of New Hampshire appointed a committee on the application of electricity to agriculture. At a recent meeting of the executive committee of the New England Division, N. E. L. A., at Boston the plans of the New Hampshire committee were set forth, and it was agreed that the work should be financed by the utilities and that the New Hampshire committee should represent all of New England and make its investigations available to all state institutions and all supporting public utilities. President F. H. Smith of the New England Division, N. E. L. A., said last week to a representative of the ELECTRICAL WORLD that it is expected that the program will require the full time of a competent field worker and that the matter is of profound importance to the utilities of the Northeast from the point of view of public relations as well as of load building.

There are 156,000 farms in New England, 15.3 per cent of which are supplied with either gas or electric service, but in Maine, New Hampshire and Vermont only about 10.5 per cent of the farms are thus equipped. Forty-eight per cent of the farmhouses, or more than four times the national average, have running water, while 51 per cent have telephones and 25 per cent automobiles. The plans call for a detailed study during the next three years of the maximum amount of electric service which can economically be used on representative farms, the present uses of electricity in representative areas, possibilities of increasing uses of electricity and other elements in the problem. Certain farms will be selected for detailed study and the survey is expected to cover about five hundred farms in representative areas.

The New Hampshire committee in charge is: Chairman, F. A. Belden, vice-president Portsmouth Power Company; J. G. Kendall, director of agriculture and home economics, University of New Hampshire; J. G. Winant, Concord; C. M. Barker, Exeter; R. D. Hunter, Claremont; E. P. Robinson, Durham; L. W. Hitchcock, professor of electrical engineering, Durham; R. D. Smith, general manager Keene Gas & Electric Company; G. M. Putnam, president New Hampshire Farm Bureau, Concord, and E. K. Sawyer, president State Grange, Atkinson.

Engineers Approve Water-Diversion Plans of Chicago

A "brief statement of findings and conclusions" is included with recommendations just made by the engineering board of review of the Sanitary District of Chicago on the much-agitated question of the diversion by that city of water from Lake Michigan. The engineering board, which has twenty-eight members, defends the city's course and approves of the desired diversion of 10,000 sec.-ft. It declares that diversion is necessary for sewage disposal, prevents pollution of the lake, improves navigation in the waterways that flow from the Great Lakes and makes hydro-electric energy available where needed. It recommends that the city make a fair settlement of all damages in the Illinois River Valley for which the Sanitary District is responsible and that it offer to contribute its proper share of the cost of lake-regulating works, to be installed in such manner as the War Department shall approve.

Under the heading "Water Power" the board of review points to the hydro-electric plant at Lockport, which supplies energy to Chicago and other cities for municipal purposes, and says that full utilization of the water in the Drainage Canal and the Des Plaines-Illinois River for the development of power is desirable. "By reason of the demand for power and its higher market value," the board says, "a cubic foot of lake water is now worth as much for power production in Illinois as at Niagara, even were the full available head between Lakes Erie and Ontario utilized. There is no economic loss to the country at large by using lake water for power in Illinois instead of at Niagara."

Asserting that at present not quite two-thirds of the power available under treaty restriction is utilized at Niagara, the board adds: "There are no treaty restrictions as to the use of the St. Lawrence water for power, but less than 10 per cent of the available power is utilized. There will be no economic loss of power on either the Niagara or the St. Lawrence River by reason of the diversion of water from Lake Michigan until 95 per cent of the available power at each location is developed." The proposed deep waterway on the St. Lawrence will, the board says, suffer no interference because of the withdrawal of 10,000 sec.ft., if regulating works are established.

Conference on Overhead-Line Materials

A conference on overhead-line materials will be held at the Engineering Societies Building, New York, on January 13, 1925, at 10 a.m. This conference is called by the American Engineering Standards Committee in accordance with recommendations of a special committee and as the result of proposals for the standardization of overhead-line materials made by the American Electric Railway Association. The purpose of the conference is to determine whether the unification and extension of specifications for

overhead-line material, such as pole-line hardware, cross-arms and pins and strain insulators, shall be undertaken. Trade and technical organizations and government departments and bureaus to the total number of thirty-nine have been invited to send representatives.

It should be noted, the Standards Committee says in issuing the invitations, that work on the following subjects is already in the hands of representative sectional committees under A. E. S. C. procedure: Wood poles, tubular steel poles, conductors (insulated wires and cables), annealed, medium and hard-drawn copper wire, zinc coating of iron and steel.

Briefer News

Technical Committees of Pacific Coast Electrical Association to Meet.—The second conclave meeting of the Technical Section of the Pacific Coast Electrical Association will be held at the Fairmont Hotel, San Francisco, on January 7 to 9. Nine bureaus will hold meetings during the three-day session.

Two Units to Go First Into Cleveland Company's New Station.—Two turbo-generators rated at 35,000 kw. each will form the initial installation of the Cleveland Electric Illuminating Company's new 300,000-kw. generating station at Avon, on Lake Erie, and not three units of 22,500 kw. each, as was originally announced. The two 35,000-kw. machines will be served by four pulverized-fuel boilers with a total rating of 40,000 boiler horsepower.

Joint Meeting of Chicago Electrical Engineers.—The Chicago Section of the Association of Iron and Steel Electrical Engineers will hold a joint meeting with the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers at the Atlantic Hotel, Chicago, on January 26, 1925, when "Automatic Substations in Steel Plants" will be the subject of a paper by G. P. Wilson.

Southwestern Commercial Section, N. E. L. A., Holds Meeting.—The Commercial Section of the Southwestern Geographic Division, N. E. L. A., held a meeting in Oklahoma City on December 15. About thirty-five heads of commercial departments of public utilities of Oklahoma and adjoining states attended the conference, and discussions were held on numerous problems connected with increasing the business of electric light and power companies. Rex I. Brown, secretary Arkansas Utilities Association, presided.

Colorado Electrical Men Meet.—Members of the Colorado Public Service Association and the Rocky Mountain Geographic Division of the National Electric Light Association held a joint meeting in Denver on December 18 and 19. W. P. Southard, general manager of the Trinidad Electric Transit Railway & Gas Company, presided for the public service group and C. A. Semrad, commercial manager of the Public Service Company of Colorado, for the electric light and power group. The promotion of a better understanding between the public and the utilities was the main topic.

Federal Court Takes Jurisdiction of Idaho Rates.—Citing a decision of the United States Supreme Court as a precedent, Judge Dietrich of the United States District Court for Idaho has overruled a motion made by Attorney-General Conner to dismiss the bill of complaint recently filed by the Idaho Power Company, Boise, for the purpose of effecting a complete review of valuation and rate decisions handed down by the Idaho Public Utilities Commission. The Attorney-General insisted that the company had not exhausted its so-called legislative remedy, but Judge Dietrich decided that the federal court should take jurisdiction. The case will probably not be heard until spring.

Large Sums Being Spent for Street Lighting in Many Cities.—A recent recapitulation of sums now being spent or soon to be spent on improved street lighting in American cities includes these sums: St. Louis, $8,000,000; Washington, $4,000,000; Syracuse, $2,000,000. Chicago has placed an order for 6,500 lighting units for residential streets, Los Angeles is spending $2,000,000 annually for new units, and Kansas City has just installed nearly 10,000 ornamental lamps. Other cities making notable expenditures for such improvement are Lansing, Columbus, El Paso, Indianapolis and Schenectady.

The International Project on the St. John.—According to information from Fredericton, New Brunswick, power from the proposed hydro-electric development at Grand Falls, on the St. John River, which the New Brunswick Electric Power Commission purposes to carry out, will be used to operate a new plant which the Fraser Companies, Ltd., and associated American interests are reported to be about to establish on the St. John River at Madawaska, Me., across from Edmundston, N. B. Application for permission to proceed with the Grand Falls development will be made soon to the International Waterways Commission. The initial costs of the development will be upward of $4,000,000.

"Wired Wireless" on Northern States System.—What is said to be the first test of "wired wireless" in the Central Northern States was made on December 20, when messages were received in Minneapolis over the 66,000-volt line from the Wissota (Wis.) power plant of the Northern States Power Company, 115 miles away. The messages were sent through an ordinary radio sending set and were clearly heard. Two different types of equipment are being tried, the system providing for "talking back" as well as sending. The Northern States Power Company now uses a leased telephone wire to Eau Claire and Chippewa Falls, Wis., and loss of contact during a storm is feared. It is believed that power lines might continue to carry messages, even if the power were shut off, where telephone lines would break.

California Water Survey Nearing Completion.—The state-wide survey of the water resources of California which is being conducted under the direction of the State Engineer is expected to be completed by March 1, 1925. On this survey it is hoped to base a state-wide policy of flood control, irrigation and power. The water survey was started in 1921, with an appropriation of $200,000 by the Legislature, and when the funds gave out in 1923 the work was carried on through voluntary subscriptions raised by the San Francisco and Los Angeles Chambers of Commerce.

Ohio Edison Company Contests Tax Valuation.—Charging that the tax valuation on property of the Ohio Edison Company in Clark County, Ohio, is excessive, the company has filed suit in the United States District Court at Springfield asking an injunction against the collection of a tax greater than $7,324 as the second installment of this year's assessment on the company's property. The half-yearly sum set by the Ohio Tax commission is $36,723, and this amount was paid in June. The Ohio Public Utilities Commission has set a valuation of $3,571,290 on the company's property in Clark County. The company's petition declares that other property in the county is taxed at only 60 per cent of its true value.

Unanimity for Central-Station Service North and South.—Batesburg, S. C., has voted to sell the municipal electric light and power plant and franchise to the Broad River Power Company for $137,500, the townspeople to get the same rates as those charged by the company in Columbia. The vote on selling the plant was 148 to 1, while that on the franchise was 148 to 0. The village of Camden, Oneida County, N. Y., is asking permission from the Public Service Commission to transfer its electric plant to the Niagara, Lockport & Ontario Power Company. The 2,200 residents of the village have voted almost unanimously to sell the plant, and the company has entered into a contract with the village to purchase it and to give twenty-four-hour service at rates lower than those now charged.

An Old Chicago Generating Station Disappears.—The recent dismantling in Chicago of the Commonwealth Edison Company's Station 11, better known as Fullerton Avenue, which is henceforward to be used as a storage warehouse and for high-tension testing rooms, removes one of three elevated power houses which for many years past have been operated only during peak-load periods. Less than two decades ago these power houses represented the latest development in electric generating equipment, from the standpoint both of economy and the size of units. There were five generating units at

Fullerton Avenue, all of them 500-volt direct-current generators driven by cross-compound Corliss engines. Four of them were of 1,500-kw. capacity and the fifth of 1,000-kw. capacity, making a total station capacity of 7,000 kw. This is only one-eighth of the capacity of one of the new turbines being installed at Crawford Avenue station.

Supplying Detroit's New Hotel with Electricity. — The Book-Cadillac, Detroit's new twenty-nine-story hotel, will be electrically operated throughout. From the electric kitchens on each floor to the electrically operated typewriters for communicating with all departments the equipment is complete. Estimated consumption of electricity by the hotel will be about 35,000 kw.-hr. a day. The hotel will be served with electricity through three different avenues, providing a maximum of protection against interruption of service. The installation would serve the normal requirements of a city of fifty thousand inhabitants.

Lawrence (Mass.) Company's New Office Building. — The removal of the offices of the Lawrence (Mass.) Gas Company to its new two-hundred-thousand dollar building on Essex Street received fit celebration in a historical "write-up" of the company filling eighteen columns of the Lawrence *Evening Tribune* for December 4. The Lawrence Gas Company supplies Lawrence with its electric light and power as well as its gas, having purchased the Lawrence Electric Light Company in 1887 and the Edison Electric Illuminating Company in 1890. Lawrence was the fourth community in the United States to have a central station with an underground distribution system. It acquired this distinction in 1883—having been preceded only by New York, Boston and Brockton. Irvin McD. Garfield is president and Leroy S. Colby superintendent of the electrical department of the company. This department supplies Methuen, Andover, North Andover and Boxford as well as Lawrence.

Premier Taschereau of Quebec Denounces Power Exportation.—Addressing a meeting in Montreal recently, Premier L. A. Taschereau of Quebec went on record as opposed to a policy of exportation of the electrical energy of the province across the border. "I believe we should exert all our efforts to keep within the limits of our province our electrical energy and power," he said. "Whatever may be the opinion of others on this point, I believe that it is a crime to export power to the United States. It is quite possible that for five years, or ten years, or even twenty years, we shall have a surplus of power that we can export, but what is twenty years or even fifty years in the life of a nation? The day that we export power to the United States to operate the mills of New England and the tramways in the big American cities, it will mean that at no time can such export be stopped. I believe that if we stick to the policy we now have, we shall compel the Americans to come and build their mills within the province."

United States Leads World in Radio Fog Signals.—The value of radio as an aid to navigation, especially as a protection against fog, has been further demonstrated during the past year, George R. Putnam, Commissioner of Lighthouses, points out in his annual report submitted to Secretary Hoover of the Department of Commerce. The United States Lighthouse Service now has twelve radio fog-signal stations in operation, with three lightships equipped for relief, and is proceeding with the establishment of other stations as rapidly as funds permit. This relatively new aid to navigation has met with great favor from mariners, as evidenced by the demand for additional installations and the equipment of vessels with radio compasses. The United States leads the world in this form of aid, having been the first to establish successful radio fog signals and now having more stations in operation than all the countries of Europe combined.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published on page 76 of this issue of the ELECTRICAL WORLD.

New England Electrical Credit Association—Boston, Jan. 13. C. A. Kane, 99 Bedford St., Boston.

Kentucky Association of Public Utilities—Louisville, Jan. 15-16. E. F. Kelley, Louisville Railway Co., Louisville.

American Engineering Council—Washington, Jan. 16-17. L. W. Wallace, 26 Jackson Place, Washington, D. C.

Electrical Safety Conference — New York, Jan. 21. R. B. Shepard, 109 Leonard St., New York.

Western Association of Electrical Inspectors — Brown Hotel, Louisville, Ky., Jan. 27-29. G. M. Miller, 1304 South Seventh St., Louisville.

Wisconsin State Association of Electrical Contractors and Dealers—Pfister Hotel, Milwaukee, Jan. 28-30. H. M. Northrup, 23 Erie St., Milwaukee.

Wisconsin Utilities Association—Hotel Pfister, Milwaukee, Feb. 5-6. J. N. Cadby, 443 Washington Bldg., Madison, Wis.

New Mexico Electrical Association—Albuquerque, N. M., Feb. 16-18. Bernard L. Wiles, Albuquerque Gas & Electric Company, Albuquerque, N. M.

American Institute of Electrical Engineers—New York, Feb. 9-12; St. Louis, April 13-17; Saratoga, N. Y., June 22-26. F. L. Hutchinson, 33 West 39th St., New York.

American Institute of Mining and Metallurgical Engineers—New York, Feb. 16-19. F. F. Sharpless, 29 West 39th St., New York.

Wisconsin Chapter of Electrical Inspectors—Pfister Hotel, Milwaukee, Feb. 17-19. A. C. Schultz, Milwaukee.

Illinois State Electric Association—Hotel Sherman, Chicago, March 18-19. R. V. Prather, Illinois Mine Workers' Bldg., Springfield, Ill.

Southwestern Division, N. E. L. A.—Eastman Hotel, Hot Springs, Ark., April 21-24. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

American Electrochemical Society—Niagara Falls, N. Y., April 23-25. C. G. Fink, Columbia University, New York.

Electrical Manufacturers' Club—Hot Springs, Va., May 19-22. S. B. Belden, Jeffrey Manufacturing Co., Columbus, Ohio.

Southwestern Public Service Association—Houston, Tex., May 19-22. E. N. Wills, 403 Slaughter Bldg., Dallas.

Electric Power Club—Hot Springs, Va., May 26-29. S. N. Clarkson, B. F. Keith Bldg., Cleveland, Ohio.

Electrical Supply Jobbers' Association—Hot Springs, Va., June 2-5. Franklin Overbagh, 411 S. Clinton St., Chicago.

National Electric Light Association—San Francisco, June 15-19. M. H. Aylesworth, 29 West 39th St., New York.

Hearing on California Agricultural Rates.—Investigation into the agricultural rates charged by the Western States Gas & Electric Company in its Stockton division will be made on the motion of the California Railroad Commission, the hearing having been set for January 6. The proceeding was instituted by the commission as the result of complaints from agricultural consumers following the rate schedules fixed by the commission earlier in the year.

Americans May Buy 500,000 Hp. of Norwegian Water Power for Operating Refining Plants.—According to a staff correspondent of the New York *Journal of Commerce*, two American corporations have applied in Norway for a supply of electrical power amounting to 500,000 hp. per annum, offering to sign a sixty-year contract and agreeing to pay $6 per annum per horsepower. It is presumed that the intention is to establish plants in Norway for refining some of the lighter ores, although nothing official has as yet been disclosed to indicate the intent or to divulge the identity of the American companies. The Electric Furnace Products Company, of which the capital is wholly American, and the Norsk Aluminum Company, of which half the capital is American, have already, the correspondent says, sixty-year contracts for 80,000 hp. and 30,000 hp. respectively. The intention of the Norwegian government to take over all power developments in sixty or seventy years makes it imperative to limit most contracts now up for execution to a period not exceeding that named.

Total Cost of Skagit Plant to Date.—According to figures recently made public by Harry W. Carroll, chief accountant of the office of the city comptroller, Seattle, that city has expended or designated for expenditure on the Skagit hydro-electric development $13,089,766. The figures show that for actual construction there has been spent $11,131,896, or $131,896 more than was expected when the bond issue of $11,000,000 was authorized to pay for the Gorge Creek unit. Other items were charges by the city light department for bond interest and discount amortization to the sum of $1,957,870 and certain pieces of construction transferred from that department. The report calls attention to several items of cost charged to the Gorge Creek construction that will be retained and will prove useful in any future development. The largest of such items is the railway from Rockport to the Skagit Camp, which cost $1,750,000. Another is the right-of-way for the transmission line, costing about $500,000. Camp supplies and equipment of a value of about $100,000 will also be retained by the department.

Men of the Industry

F. A. Merrick New Westinghouse Vice-President

F. A. Merrick, who has just been elected vice-president and general manager of the Westinghouse Electric & Manufacturing Company, as already announced in the ELECTRICAL WORLD, is a native of New Jersey and received his technical education at Lehigh University. Shortly after graduation he was employed by the Steel Motors Company, where he was responsible for many important electrical inventions and rose to the position of chief engineer. Subsequently he joined the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., where he had charge of the production of street railway motors. After the formation of the Canadian Westinghouse Company,

F. A. MERRICK

Ltd., in 1903 he was sent there as superintendent, and later became manager of works and finally vice-president and general manager. During the war Mr. Merrick had charge of the factory of the New England Westinghouse Company at Chicopee Falls, Mass., and after the war he was stationed in London for two years as special representative of the Westinghouse Electric International Company. He then returned to Canada to resume the duties which he has just relinquished.

J. L. McQuarrie has been appointed chief engineer of the International Western Electric Company to succeed E. B. Craft, who has become vice-president of the Bell Telephone Laboratories, Inc. Mr. McQuarrie has held the title of assistant chief engineer, his service with the Western Electric Company having been continuous since 1894.

Clarence G. Johnson of Chicago will soon after the new year become vice-president and chief engineer of the United Power & Light Corporation of Kansas. This is a recent consolidation of fourteen public utility enterprises, serving about 150,000 people in 100 Kansas communities, which has been formed under the control of C. L. Brown and associates. The center of the company's activities is at Abilene. Mr. Johnson brings to it fourteen years' experience with the public utility properties formerly owned and operated by I. C. Elston, Jr., and associates, under the name of the Union Utilities Company. Mr. Johnson was chief engineer of the latter company from its organization in 1916 until its recent dissolution, following the sale of the constituent properties.

H. W. Darling Becomes Vice-President in G. E. Organization

Henry W. Darling, for more than thirty years treasurer of the General Electric Company, has resigned and on January 1 was succeeded by R. S. Murray. In accepting the resignation of Mr. Darling as treasurer the board of directors elected him a vice-president with such duties as shall be assigned to him by the president. Mr. Darling has been intimately associated with the financial affairs of the General Electric Company from the time the company was organized in 1892 by the consolidation of the Edison General Electric and the Thomson-Houston companies.

Gerard Swope, president of the General Electric Company, is sailing for Europe today (January 3) on the Cunard liner *Aquitania*. Mr. Swope will remain abroad until about March 1.

George Harris has been appointed manager of the recently established branch of the Wisconsin Power & Light Company at Dodgeville.

L. K. Hayes, manager of the Harlan branch of the Kentucky Utilities Company, has been transferred to the Pineville office of that utility.

V. V. Gunsolley has been transferred from the valuation department of the Kansas City Power & Light Company to the research engineering department, where he will serve in the capacity of safety supervisor.

R. S. Murray, who has been assistant treasurer of the General Electric Company since 1910, has been selected to succeed Henry W. Darling as treasurer, Mr. Darling having been appointed a vice-president of the company.

E. R. Commander, formerly associated with the Carolina Power & Light Company, Raleigh, N. C., has recently joined the operating department of the Alabama Power Company as retail operating engineer.

Ernest S. Fitz, who has been identified with the betterment division of Stone & Webster, Inc., Boston, has been appointed general superintendent of the Eastern Texas Electric Company, Beaumont, Tex.

Harry B. Gilmore, for the past sixteen years New England manager of the Western Electric Company, Inc., with offices at Boston, has been appointed assistant secretary of the company with headquarters at New York. He will take up his new duties about January 5. Mr. Gilmore is one of the most widely known executives in the electrical supply jobbing field in the Northeast. He has been chairman of the contact bureau of the New England Division, N. E. L. A., for the past two years and has long been an ardent worker on behalf of the larger good of the electrical industry to be attained through the co-operation of its different branches.

J. R. Kearney Appointed Matthews Sales Director

James R. Kearney has been appointed director of electrical sales of the W. N. Matthews Corporation, St. Louis, in charge of all electrical sales in the United States, Canada, Mexico and Cuba. This recognition comes to him after an association of several years with the Matthews organization, during which he has served as special representative, then in charge of sales west

J. R. KEARNEY

of the Mississippi River, later in charge of sales west of Pittsburgh and more recently in all of the United States. Mr. Kearney is the inventor of a number of the electrical specialties made by the corporation, all of which have been steps forward in pole-line construction and protection. Before joining this company he had varied experience in the design, construction and operation of power plants, having served in all positions from groundman to engineer.

H. R. Cloud, formerly engaged in power development work with the subsidiaries of the Central Indiana Power Company, has joined the Pennsylvania Edison Company as engineer in the commercial department, with headquarters at Easton, Pa.

F. M. Black has been appointed vice-president of the Winnipeg Electric Company in charge of finance. Mr. Black, who is a prominent figure in financial circles in Canada, has resigned his portfolio as Provincial Treasurer in the Manitoba Cabinet to affiliate himself with the electric company. He has been financial manager and president of the Calgary Board of Trade and a member of the Public Utilities Commission of Alberta. Mr. Black is a native of Kilmarnock, Scotland.

Commission Rulings

Electric Service for Heating Only Justified Under Certain Circumstances.—Objection to the cooking and heating rates of the California Oregon Power Company was made by consumers whom the Oregon Public Service Commission found to be using electric service for house heating. The commission thereupon declared that electricity should be employed for heating only in instances where its convenience justifies the reasonable cost thereof. The ratepayers as a whole, upon whom the cost of utility service must ultimately rest, cannot afford to carry the burden of ordinary heating at rates which would be satisfactory to the heating consumers.

Power and Water Company Allowed to Discontinue Necessarily Unprofitable Service.—The California Railroad Commission has granted permission to the Mokelumne River Power & Water Company to discontinue service as a public utility, although it has had that status for more than sixty years, its business having become necessarily unprofitable owing to the closing down of the quartz mines it formerly served with hydraulic power and the general substitution of electrical energy for such power. Proper provision for enabling the customers of the company to develop or obtain other water supplies was made a prerequisite.

Reward for Efficient Management.—In fixing a rate of return for the Montesano Telephone Company the Department of Public Works of the State of Washington said: "When a public utility conducts its affairs in an extravagant and unwise manner, we do not feel called upon to establish for it rates that will give it ample return despite this mismanagement. In other words, there should be a penalty paid for mismanagement, and, conversely, there should be some reward for good and economical management. If this were not so, there would be no inducement for a public utility to conduct its business in a careful and economical manner; but, since it is the duty of a utility to be economical and careful in the conduct of its business, the fruits of good management should not go alone to the utility, but the patrons should have their share also."

Method of Abandoning a Small and Unprofitable Utility.—Authority to abandon an electric utility formerly operated in connection with a garage business to serve a few neighbors, but no longer profitable after the discontinuance of the garage business, was granted by the New Hampshire Public Service Commission on the application of the Van Auken utility plant. The commission provided that the utility property should be offered at once for sale to any one who might wish to purchase it for the purpose of continuing its operation as an electric utility at a price not exceeding that which could be obtained for it if disposed of otherwise. The commission said: "It is very important that the method of abandonment be reasonable. This is a matter of public interest, and it is ultimately up to the consumers to take such action as may be necessary to secure the permanency of this service. The public is aware that it may lose this service. It should be permitted to preserve it, if it so desires."

Regulation of Rates Not Related to Issue of Securities.—Approval of an amendment to the articles of incorporation of a public utility creating an issue of non-par-value common stock and authorizing the exchange of par-value common stock for non-par-value common stock was granted by the Arizona Corporation Commission to the Central Arizona Light & Power Company. The commission said: "From the standpoint of the regulation of the public utility and the determination of rates for its service, this is a matter which is of no importance to the patrons of the company. It can in no way affect the rates of charge if the junior securities of the company are in the form of non-par-value stock or in the form of stock of stated par value. It is desirable from the public standpoint that the financial structure of the public utility companies be well balanced, so that there will be a proper proportion of capital represented by bonds, preferred stock and common stock. It is universally recognized that if our public utilities are to be of sufficient strength to attract capital for major financing at reasonable rates of interest, their junior financing through the sale of preferred and common stocks must be carried on in proper amount, so that ample equities will be back of the major securities."

Recent Court Decisions

Disposition of Power by Water Users' Association Not Enjoined for Anticipated Later Insufficiency.—Brewster et al. vs. Salt River Valley Water Users' Association was a suit by shareholders of the association to enjoin the execution of a contract to unwater certain waterlogged lands of the Salt River project and to utilize such waters to reclaim lands adjacent to but outside of said project. Various reasons were urged against the validity of the contract, one of which was that it provided for furnishing electric power to an irrigation company to operate wells and pumps. It was held by the plaintiffs that this might prevent the association members from getting power as they needed it or make it impossible to fill other contracts to deliver power. The Supreme Court of Arizona refused to grant anticipatory relief, saying that there would be time enough to apply to the court when the conjectural wrong was imminent or actually occurring. (229 Pac. 929.)*

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Recovery of Damages for Breach of Coal Contract.—In rendering a verdict for the plaintiff in Detroit Edison Company vs. Wyatt Coal Company, a suit over a coal contract, the United States Circuit Court of Appeals in West Virginia found that a contract for sale of coal providing for payment of 20 cents damages for each ton of coal not delivered on one hand or not accepted on the other provided for liquidated damages and not for a penalty, and claim for damages could not exceed such 20 cents per ton. The failure of the purchaser of the coal to make the deduction of 20 cents per ton was not a waiver of claim for such damages. The action to recover damages was an action "to recover money" founded on written contract and fell under the ten-year statute and not the five-year statute of the state. (1 (2d) Fed. 788.)

Oklahoma Supreme Court Outlines Principles of Fair Valuation.—Reversing a decision of the Corporation Commission, the Oklahoma Supreme Court, in Western Oklahoma Gas & Fuel Company vs. the State of Oklahoma and the Corporation Commission, held that a public utility is entitled to charge a rate for its service that will produce a reasonable return upon the present fair value of its investment used and useful. The court interprets "present fair value" to mean that valuation which during the period of time likely to be covered by the duration of the rate to be fixed will fairly represent the average value of the property. The court also said: "In determining the present fair value we must consider the original cost of the property. Generally speaking, the degree of influence which a consideration of the original cost of the property should have upon the court in determining the present fair value is inversely in proportion to the lapse of time and changes in prices and values since the property was constructed." The proper expense of operating a utility during the years to be covered by the rate to be fixed may be determined largely by the experience of the company in the past, the court holds. When such cost is fair upon its face and it does not appear that the conditions surrounding any item of expense were unusual or different from probable future necessities, the burden is upon the party attacking such expense to show that the estimate of a similar expense for the future would be unfair. Other findings of the court were that extraordinary expense in one year should be prorated over a period of years and that when excessive leakage is shown the future cost of operation would be estimated on the basis of the leakage experienced by the company in the past. Overhead expense in construction and "going value" are elements to be considered, the amount to be determined by the evidence in the case. Working capital must also be made a part of the valuation for rate-making purposes. The court also held that greater weight should not be given to the testimony of appointees and employees of the commission than to evidence presented by witnesses produced by the utility where such witnesses are of equal understanding and appear to be of equal credibility.

Manufacturing and Markets

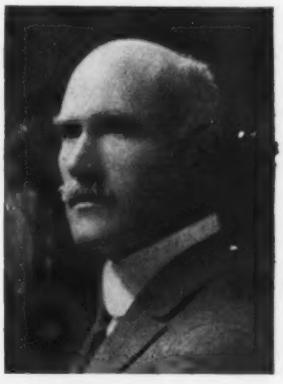
Better Business This Year

Leaders of the Industry Unanimously Predict Prosperous Year—Factors Governing Business Are Considered in More Healthy Condition

IMPROVING CONDITIONS and a fairly active and prosperous year have been unanimously predicted by seven of the leading men of the industry who have been approached by the ELECTRICAL WORLD with the suggestion that they put their opinions on record. The uncertainty of the political situation has been removed. We have a strong President and a stable administration in Washington. The foreign situation is also slowly and steadily improving. To the industry, therefore, the new year appears as one of good promise, practically all factors governing the business situation being in a more healthy condition, and all signs point to an accelerated expansion. Thus 1925 opens auspiciously and brings with it a confidence that there will be a strong market in all fields and a continuing growth for the electrical manufacturer.

More Actual Orders Recently—Prospects for New Year Bright

E. R. FISH
President American Boiler Manufacturers' Association and Vice-President Heine Boiler Company



THE curtailment in the past year of manufacturing activities in practically all lines has naturally resulted in fewer power-plant replacements and extensions generally. While central-station extension programs in anticipation of future demands have been carried along to some degree, they have not been so active as would have been the case had conditions approximated normal. The outcome of the presidential election has undoubtedly restored confidence in financial and manufacturing circles, in consequence of which there have been within the past few weeks not only more inquiries but considerably more actual orders placed than for many months preceding.

The prospects for the coming year we regard with much optimism, believing that conditions generally relating to the electrical industry in all its phases, as well as all other lines, will require additional or more economical apparatus, including boilers, with resulting activity in all our shops. Owing largely to high operating charges, the demand for large boiler units and working pressures—far higher than was the practice of but a very few years ago—continues to grow and has necessitated increased equipment for boiler shops, with the result that the larger factories were never so well prepared as now to supply any requirements.

E R Fish

All Factors Governing Business in More Healthy Condition

GERARD SWOPE
President General Electric Company

I LOOK forward with optimism to the year 1925; it should be a good business year in general and for the General Electric Company as well. For the past two months, our business has shown improvement over the earlier months of the year, although not reaching the same volume as in the corresponding period of last year.

The General Electric Company's business, because of its great diversity and application to practically all industries, naturally follows the general business trend quite closely, but its peaks and depressions are perhaps not so extreme as in many other industries because of this diversification.

Gerard Swope

Every Business Sign Post Points to Accelerated Expansion

W. A. LAYMAN
President Wagner Electric Corporation, St. Louis

EVERY business sign post points to an accelerated expansion of the electrical industry during 1925. Look where you will, the evidence is obvious. Not in the history of the industry have there previously existed such receptive conditions for electric public utility securities. Conservative insurance and trust companies are incorporating the bonds of electric service companies in their holdings—many of them for the first time. The small investor from coast to coast is buying electric service preferred stocks. Money as never before is available for meeting every public demand in the distribution of electrical energy and in the manufacture of electrical equipment and supplies. The ever-lessening cost of electrical energy is making it an economic necessity for industrial purposes, and the continuous evolution of the economic conditions of home life is compelling the rapid electrification of the home.

With returning general prosperity in all fields of industry and business, there will inevitably come corresponding growth for the electrical manufacturer. The condition of excess capacity which has prevailed in some branches of the

electrical manufacturing industry since 1920 promises to be all absorbed in the ensuing year, and the excessive price competition which has made these lines of business unprofitable during 1924 will no doubt be ameliorated, if not entirely relieved, in the early months of the year. The growing diversity of the applications of electric power is a constant challenge to the manufacturer of electrical equipment, and with the display of proper virility in the placing of its energies, every electrical industry should find itself in a favorable economic position during the ensuing year.

W. A. Layman

A Fairly Prosperous Year in 1925 with Right Legislation

OTTO H. FALK
President Allis-Chalmers Manufacturing Company

I BELIEVE the business outlook in the electrical industry is favorable for 1925. This pertains not only to the Allis-Chalmers Manufacturing Company but to all industries engaged in that line of manufacture. It is true that competition is particularly keen, but with the continued increased demand for the uses of electricity in the operation of business and in the home, there should be large developments in this line.

Generally speaking, the volume of new business obtainable in 1924 was not quite up to that of 1923. Doubtless, the political situation contributed to the tendency to withhold action on future plans until the uncertainty involved in the election was removed, with the result that in the last two months of 1924 there have been an increase in orders placed and general improvement in the business situation. Economic conditions appear to be sound, and a greater feeling of confidence exists throughout the country. If the tendency of new legislation is to encourage the operation of legitimate business, there would appear no present sufficient reason why the electrical industry should not enjoy in 1925 a fairly prosperous year.

Otto H. Falk

Expect Increased Business During This Year

E. M. HERR
President Westinghouse Electric & Manufacturing Company

THIS should be a prosperous year for the electrical manufacturing industry. Very definite improvement is noticeable in building construction, general manufacturing and agriculture, and the present position of the railroads is much more satisfactory than it has been for many years. All of these circumstances should react favorably on the electrical industry. Interest in radio continues to grow, and this business, which already amounts to more than $300,000,000 annually, promises to become considerably larger.

Finally, the growing tendency to interconnect large electric power stations is creating an important demand for additional current-controlling equipment. Altogether, the electrical manufacturing industry can expect an increasing volume of business during this year.

E. M. Herr

Look for Fairly Active Year and Generally Better Business

C. G. DU BOIS
President Western Electric Company

THE year 1924 has been the greatest in the history of the Western Electric Company in relation to both orders received and business billed. The sales will approximate $300,000,000, or about $1,000,000 for every working day. This volume of business is a reflection of the steadily increasing use of electrical products over the period since the war, in particular the accumulated demand for telephone service. This record performance has been made in spite of the fact that the prices for most electrical equipment were during the past year generally lower than at any time since the war.

The fundamental improvement in the economic situation at home and abroad points to generally better business. During 1924 new telephone construction has measurably caught up with the hitherto unfilled demand, so that we do not expect quite so much business from telephone companies in 1925. However, other departments of our company will probably do more business in 1925 than in the year just closed. On the whole, we look forward to a fairly active year, somewhat less so than during the year 1924, but more so than in 1923.

C. G. DuBois

Increase in Executive Efficiency Will Produce a Banner Year

EDWARD N. HURLEY
President Hurley Machine Company

BUSINESS in 1924 was fairly good considering the amount of effort that business men put forth to obtain it. The new year will be better if our executives themselves will speed up and set a pace for their employees in office and factory. We are prone to expect increases in business by the magic-wand method of making surveys, holding conferences, etc.; but business does not increase this way. The real reason for slow progress is that we are not working hard enough.

Confidence is always necessary to improve business, but confidence without real effort will show only mediocre results. If our business managers increase their efficiency 10 per cent in 1925, there will be no question that it will be a banner year. Let us concentrate and put forth that extra effort that we all hold in reserve, and 1925 balance sheets will speak for themselves.

Edward N. Hurley

Are Annual Approximations of Value?

Opinions from Various Manufacturers Who Doubt the Usefulness of Any Man's Guess—The Need for Accurate Industry Statistics

FOR a number of years the ELECTRICAL WORLD has compiled an annual approximation of the total production of the principal manufactured products of the electrical industry. The need for statistics on electrical manufactures is widely recognized. As the industry grows and the number of manufacturers producing a given commodity increases it becomes more and more important that there be a dependable basis for estimating the market for the various electrical devices and materials, that the manufacturer may be able to avoid both overproduction and underproduction, for whether the price be depressed or inflated somebody inevitably loses and the market is accordingly demoralized.

Under present conditions nobody knows accurately the total production or the total sales for the entire industry of any commodity with the exception of the comparatively small number of products that are so controlled by patents as to be accounted for accurately. Nor has the manufacturer any definite knowledge of the extent of the stocks on hand; therefore he is compelled to guess and set his production schedules according to his intuition and his judgment, based on the data he possesses covering his own past sales and on the gossip of the trade.

APPROXIMATE DATA PRESENTED

The compilation of figures for the year 1924 is presented here. This table has been developed through the cooperation of some manufacturers who have contributed their careful estimates of what they consider to have been the aggregate production of all manufacturers producing the lines that they are interested in. These estimates were gathered during the month of December and come only from men who are representative manufacturers in each field. They are offered as the nearest approximation possible at the present time. They are not—they cannot be—absolutely accurate or inclusive under the circumstances.

Several estimates have been obtained on each classification, and these estimates are found to vary widely. An approximation, based on the information obtainable, is, therefore, made. It has been tabulated once more because of the evident desire on the part of many men to help develop some sort of statistics on electrical production that can be used as a starting point in reckoning the consumption and demand. It is quite apparent, however, that such approximations are a poor and inadequate substitute for the accurate statistics which the industry needs. For whereas a very large number of electrical manufacturers have submitted the best estimates they could covering the products they sell, a great many others have felt themselves incompetent to do so. Many utterances show the state of mind that today exists within the electrical industry concerning this inability of manufacturers to know the needs of their markets and to make their plans backed by definite statistics in support of their opinion. For example:

From a prominent manufacturer of telephone equipment:

Although we are large manufacturers of this line, we do not feel that we are in a position to give any kind of estimate that would be of value, nor do we presume that any other manufacturer can accomplish the result without making a detailed analysis which can be summed up in complete form.

From a large manufacturer of lighting equipment:

Whatever figure we would give you would be nothing more than a wild guess, because we have no statistics or source from which we would be able to obtain reliable information. It would be just as easy for you, or any one else, for that matter, to guess at this figure.

From a leading manufacturer of wire:

We are not at all averse to assisting in the compilation of these statistics, which we feel would be of considerable value to the industry, provided figures so obtained were reasonably accurate; but we feel that the information available to hand is so vague and indefinite that any estimate we might offer would be so unreliable as to have little or no value.

From a porcelain manufacturer:

The porcelain industry is one of those referred to in the letter from Mr. McGraw which was read at the meeting of the Associated Manufacturers of Electrical Supplies. No industry statistics have ever been gathered, and any guess that I might make would be as wild as some of those Mr. McGraw referred to. I might say for your information that a very earnest effort is being made in the electrical porcelain section of the A. M. E. S. to gather industry statistics.

From an important manufacturer of wiring devices:

We do not agree with the figures as shown in your letter of the tenth, and as we understand that these were made up by guesses, we do not think it would be very helpful to make another one. Several of your figures, I know, are off very decidedly, and we would not care to estimate the total amount of business for which there

DATA ON THE PRODUCTION OF ELECTRICAL EQUIPMENT AND SUPPLIES DURING 1923 AND 1924

Item	Number of Units		Manufacturer's Value	
	1924	1923	1924	1923
Attachment plugs	20,000,000	.....	$2,500,000	.....
Batteries, storage	800,000	.....	6,500,000	$5,000,000
Batteries, storage, replacements on autos.	2,750,000	.....	28,500,000	.....
Batteries, dry	120,000,000	115,000,000	.....	.....
Books and magazines, electrical	.....	.....	10,000,000	10,000,000
Cookers, electric	30,000	20,000	900,000	.....
Curling irons	175,000	300,000	130,000	.....
Commercial lighting units	6,100,000	6,000,000	5,000,000	8,000,000
Clocks, electric	250,000	.....	5,000,000	.....
Dishwashers	5,000	4,350	2,750,000	2,000,000
Fixtures, residential	.....	.....	50,000,000	.....
Fuses, renewable and non-renewable	.....	.....	5,750,000	5,750,000
Farm lighting plants	45,000	.....	10,500,000	.....
Farm substations	.....	.....	1,000,000	.....
Farm equipment, churns, cutters, milkers	.....	.....	1,200,000	1,200,000
Fans	775,000	721,000	10,060,000	8,550,000
Generators, waterwheel	1,100,000	1,200,000	8,000,000	.....
Generators, steam turbine	1,700,000	1,600,000	27,000,000	32,300,000
Grills	257,000	190,000	.....	1,118,000
Home moving picture projectors	65,000	40,000	100,000	.....
Hot plates	250,000	250,000	1,000,000	1,000,000
Heating pads	225,000	230,000	750,000	780,000
Hair dryers	21,500	.....	540,000	.....
Lamps, vacuum	214,000,000	191,000,000	56,000,000	55,000,000
Lamps, gas filled	64,000,000	54,000,000	36,000,000	35,000,000
Lamps, carbon	1,000,000	2,000,000	125,000	250,000
Lamps, miniature	210,000,000	175,000,000	30,000,000	25,000,000
Meters, service watthour	1,817,000	1,950,000	16,500,000	18,100,000
Meters, switchboard instruments	.....	.....	5,000,000	3,000,000
Motors, fractional	.....	.....	30,000,000	30,000,000
Motors, 1 hp. to 50 hp.	.....	.....	57,500,000	66,000,000
Motors, 51 hp. to 200 hp.	.....	.....	9,000,000	9,900,000
Motors, above 200 hp.	.....	.....	2,500,000	2,500,000
Key sockets	.....	.....	3,600,000	.....
Keyless sockets	.....	.....	3,000,000	.....
Ironing machines	50,000	55,000	.....	.....
Irons	2,150,000	2,000,000	6,150,000	6,000,000
Industrial heating appliances	.....	.....	1,500,000	1,500,000
Industrial control apparatus	.....	.....	25,000,000	29,000,000
Panel boards	.....	.....	400,000	.....
Percolators and hollow ware	200,000	.....	1,000,000	.....
Poles, steel	.....	.....	1,300,000	900,000
Poles, wooden	650,000	800,000	17,000,000	20,000,000
Porcelain knobs, tubes, cleats, etc	100,000 lbs.	.....	2,000,000	.....
Portable drills, valve grinders	150,000	.....	7,500,000	.....
Pull sockets	.....	11,600,000	7,700,000	.....
Pumps, electric driven	75,000	75,000	10,000,000	.....
Sewing machines	202,000	162,000	6,060,000	4,860,000
Rigid conduit	165,000 tons	132,000 tons	17,900,000	16,500,000
Radiators and heaters	425,000	425,000	1,300,000	.....
Radio, amateur sets and parts	.....	.....	200,000,000	.....
Radium locator devices	1,500,000	1,000,000	375,000	250,000
Ranges, electric	44,500	43,000	4,500,000	4,200,000
Receptacles	.....	.....	2,800,000	.....
Refrigerators, electric	17,500	16,000	4,050,000	3,700,000
Toasters	470,000	.....	1,717,000	.....
Toys, electric	2,000,000	2,000,000	3,600,000	3,500,000
Transformers—distribution type	.....	.....	13,600,000	14,000,000
Transformers, power type	.....	.....	16,800,000	14,000,000
Transformers, bell-ringing type	850,000	950,000	700,000	.....
Switches, safety	1,333,000	860,000	4,610,000	2,900,000
Switches, flush	.....	.....	5,100,000	.....
Switches, exposed	.....	.....	1,200,000	.....
Signs, displays, flashers, electric	.....	.....	53,000,000	.....
Vacuum cleaners	860,000	935,000	30,460,000	32,400,000
Vibrators	38,000	85,000	750,000	900,000
Violet ray outfits	150,000	.....	1,500,000	.....
Waffle irons	100,000	.....	600,000	.....
Washing machines	561,000	560,000	40,800,000	39,200,000
Wire, total rubber covered	.....	.....	65,000,000	78,000,000
Wire, total code	2,184,000,000 ft.	2,114,500,000 ft.	22,500,000	26,300,000
Wire, No. 14 code	1,300,000,000 ft.	1,268,700,000 ft.	8,190,000	13,700,000
Wire, flexible cords	275,000,000 ft.	226,000,000 ft.	3,932,000	3,400,000

are no statistics available as to the total consumption.

From a motor manufacturer:

We do not maintain a statistical department such as are maintained by the larger companies like the General Electric and Westinghouse, and we do not feel therefore that we are in a position to make an intelligent estimate. We would prefer to be excused.

From a manufacturer of electric tools:

We are frank in saying that any estimate that we would give you would be entirely too much of a guess to be of any value. We do not feel that we have any information at our disposal that would enable us to make an intelligent guess.

From another motor manufacturer:

The product of our works is such a small proportion of the total production in this country that we do not feel competent to make an estimate. Unless the larger companies are willing to give you a close approximation, then the last Census Bureau figures, subjected to some probable percentage of last year's operations, would be most suitable for your purpose.

From a large fuse manufacturer:

We shall have to ask to be excused from furnishing this estimate as we have no figures readily available that would enable us to venture a guess.

From a well-known manufacturer of flexible conduit:

We do not think that any guess we can make will be of any value to you, and would therefore very much prefer to be excused from filling in the figures off-hand.

From another wiring device specialty manufacturer:

I do not like to guess at anything of this kind, and any figures that I put down would only be a guess.

From an electric truck manufacturer:

I regret that I do not have any reliable figures. The electric truck manufacturers do not exchange such data.

From another manufacturer of lighting equipment:

Very foolish to estimate, as we told you in our letter last year on the same subject. Wait till Department of Commerce gets its reports ready after the first of the year and you can come somewhere near the correct total.

TYPICAL ATTITUDE OF THE MAJORITY OF MANUFACTURERS

A storage-battery manufacturer says laconically, "Can't guess," while another electric tool manufacturer voices the following opinion, which seems to be typical of the attitude of the great majority of electrical manufacturers:

We are not in a position to give you any reliable information along these lines. We will know at the end of the year how many electric drills we sold, but can only guess at the quantities manufactured by some thirty or forty other concerns that are in the same line of business. In fact, we should like very much to get some reliable figures as to the number of electric drills and electric grinders manufactured and sold by all the companies in the electric tool business in the United States. We would suggest that you might be able to obtain the figures from each of the electric tool manufacturers, and by adding them all together you would get the total number manufacturerd and sold. Our company would no doubt be willing to advise you as to the number we manufactured and sold, although we should not want you to give this information to our competitors. We should like to have you advise us, if consistent, provided you get this information, as to the total quantity manufactured and sold, and there would, of course, be no objection on our part to competitors receiving the same information. In other words, if there are 100,000 electric drills and, say, 25,000 electric grinders manufactured and sold by all the companies, we would know what the market was and would also know what percentage of the business we were getting, and that information would be of great interest to us. We do not expect, nor care particularly, to know the number of tools each of our competitors is making.

In the face of such an attitude so widely expressed the continued publication of these approximations on electrical manufacturing production would seem to be doubtful, in spite of the fact that a very much larger number of men in no less authority than the men quoted have willingly co-operated in providing the estimates. The great need is undoubtedly for accurate industry statistics on productions, sales and stocks, embracing at least 60 to 75 per cent of the total volume sold, based on actual reports from the manufacturers concerned, submitted in confidence for compilation and publication either through the Department of Commerce or through the ELECTRICAL WORLD as the weekly newspaper of the electrical industry. Secretary Hoover has offered the facilities of the government, but there is fear in many minds lest after Hoover there might come some less intelligent and sympathetic Secretary of Commerce with too great zeal for interference in the functions of business. The pages of this paper have been already offered to the manufacturers, and reference was made to this in one of the letters quoted. It remains for the many manufacturers of electrical products who recognize the great economic value which such statistics would have to marshal industry opinion and lead it to a point which will permit the plan to be put into operation.

Meanwhile, are these annual approximations of interest and value to the readers of the ELECTRICAL WORLD? A frank expression of opinion will be appreciated by the editors.

Brussels International Fair

THE sixth official Brussels Commercial Fair, an annual international business exposition, will be held from March 25 to April 8, 1925, in the Gardens and Halls of the Cinquantenaire. The fair is organized by the city of Brussels and the Belgian government and is under the high patronage of King Albert. Particulars concerning the official regulations of the fair, insurance, advertising form of application for space, etc., can be obtained by addressing the executive committee, 19 Grand Place, Brussels, or the Belgian Consulate at 25 Madison Avenue, New York City.

Safety Council to Review Foreign-Made Articles

THE executive committee of the National Safety Council has just passed a resolution directing the attention of its members and others to the accident hazards inherent in certain imported electrical and gas toys, decorations and heating and cooking utensils of foreign manufacture. The resolution points out the desirability of having all such foreign-made articles meet the standard of similar articles of American manufacture being sold in this country. It was further resolved that a committee be appointed to review this situation and that it be empowered to co-operate with committees from other interested organizations, such as the National Fire Protection Association, National Bureau of Casualty and Surety Underwriters, Electrical Manufacturers' Council and American Gas Association, to prepare plans for the supervision of foreign-made articles with a view to having them comply with the various United States casualty and fire prevention standards before being sold in this country.

Hoover Forecasts Prosperity

Economic Structure Is on More Solid Foundations—Steady Progress Toward Peace and Prosperity

A FORECAST of the business future must be simply a weighting of the economic and political forces in motion. The annual survey of the Department of Commerce shows that the New Year begins with the economic structure of the world upon more solid foundations than at any time since the war, according to Secretary Hoover. With the exception of a few spots of secondary importance there has been during the past year a real advance toward social, economic and political stability throughout the world. Generally more goods are being produced, there is fuller employment, there are higher standards of living, more assurance of economic stability for the future and more promise of peace than we have seen for many years. The world is by no means free from liability to economic shock, yet the forces today in motion all tend to great promise for the forthcoming year. It can be assuredly stated that we are on the march of wholesome recovery from the war and there is no present indication of inflation.

LITTLE SLACKENING IN CONSUMPTION OF MAJOR ARTICLES

While there was some slackening of manufacturing production as a whole in the spring, due in part to the uncertainties of election and in part to reduction of accumulated stocks, yet there was but little slackening at any time in consumption of major articles as shown by the continued high levels of car loadings, of sales of wholesale and retail establishments and of construction activities. The end of the year finds us with a recovered industrial production at practically the same levels as a year ago. The outstanding economic development of the year in our own country has been the very large recovery in agriculture after its two-year lag behind the recovery of industry.

The building construction work of the whole country has maintained high activity. While the shortage, particularly of housing and business buildings, due to the cessation of construction during the war has been to a large degree overcome, yet continued high real wages and general prosperity create a demand in excess of that due only to increasing population, because of the insistence on the part of a population of rising standards of living for more elbow room and better housing generally. Altogether, forces in motion both at home and abroad mark solid progress toward peace and toward prosperity for the coming year.

Business Conditions

PROMINENT in the week's news is the active purchasing by industrial firms, and particularly by textile mills, in the Southeast in closing electrification contracts and in New England, where special interest has been aroused in better illumination. Buying by utilities is keeping up well, many medium-sized orders having been placed.

Steel-mill operations have been practically up to capacity over the holidays —not a usual condition for this period. The North American Company has announced that $41,500,000 will be spent during 1925 for extensive improvements to its utility properties. Henry L. Doherty & Company has announced an expenditure of $2,000,000 for the construction of about 100 miles of a new 130,000-volt steel-tower transmission line in Ohio, work on which is now under way. Three and a half million dollars is also to be spent in southern and central New Jersey for telephone plant and line extensions.

In New England industries are purchasing material actively, and textile mills are becoming interested in improved illumination. Sales are good in the New York district. Utilities are buying well and are placing many medium-sized orders in this territory. In the Southeast several satisfactory textile installation contracts have been closed, and additional similar contracts are expected to be closed early in the year. The year closes with good buying in the Middle West, and contrary to expectations many equipment orders were received from utilities. On the Pacific Coast business has tapered off somewhat after a good season. Good weather with abundant rainfall in this section gives unusual promise for a bumper year.

Copper, Tin and Zinc Prices Continue to Increase

New high records have been established for copper, tin and zinc in the non-ferrous metal market. The demand has been somewhat reduced during the holiday period, but producers are holding firmly to their prices. Copper sales are heavier than usual at this period and is believed now to come from consumers who refrained from purchasing during the recent advances. Most of the large producers have been quoting 15 cents, but sales at this price have been meager.

The American Smelting & Refining Company is maintaining its official contract price for lead at 9.60 cents. Buying is in moderate volume, but consumption has not decreased any. Zinc is being purchased mostly for export. Domestic buyers have not been very active, but brass manufacturers are working at increased capacity. The demand for tin has been good.

NEW YORK METAL MARKET PRICES

	Dec. 24, 1924 Cents per Pound	Dec. 31, 1924 Cents per Pound
Copper, electrolytic	14⅛	14.90
Lead, Am. S. & R. price	9⅛	9.60
Antimony	15½	17
Nickel, ingot	29½	29½
Zinc, spot	8.	8⅛
Tin, Straits	57½	58⅛
Aluminum, 98 to 99 per cent	28	28

New England Industries Actively Purchasing Material

INCREASING activity in industrial engineering circles dominates the apparatus field in New England as the new year arrives. Textile mills are becoming interested in improved illumination, and many water-power proposals are on the boards in all sorts of manufacturing. A Lawrence (Mass.) paper mill has purchased two hydraulic turbo-generators of 500 kva. and 1,000 kva. rating, each; a paper mill at Rumford, Me., has contracted for a 2,500-kva. generator, and a Connecticut manufacturer is planning to develop a 12,000-hp. hydro-electric plant with provision for selling surplus energy to other distributors or users. Automatic power-plant and substation control apparatus is in good demand, and redevelopment work is active. A 750,000-volt testing outfit has been ordered by the Simplex Wire & Cable Company, of Cambridge, Mass.

With the turn of the year central stations will doubtless figure more prominently in the market for generating and substation equipment. Favorable price conditions caused the sale of two carloads of pole-line hardware.

Good Sales in New York District—Utilities Buying Well

DESPITE the holiday season and a slight slackening of business, good sales are reported by manufacturers. Many medium-sized orders were received from utilities which in the aggregate are large. As expressed by one company, utility buying is keeping up well and it is expected not only to continue but to increase. One order placed was for approximately $175,000, covering feeder regulators principally, but also including some circuit breakers. Another order was for $100,000 worth of miscellaneous switching equipment for a Southern power company. Several other orders are expected to develop next week.

Very good business has been transacted by jobbers during December. Sales of radio material have contributed largely to the results. Copper prices continue to advance, so that further increases in copper products may be again expected.

Textile Electrification Active in the Southeast

SEVERAL very satisfactory textile installation contracts were closed in the Southeast last week. Among the apparatus required will be motors, oil switches and high-tension transformers. Other large contracts of a similar nature are expected to be placed immediately after directors' meetings the first of January. The largest dealer in oil-engine generating sets and domestic electric pumping equipment reports that in the past two weeks business in these lines has been record-breaking and that the outlook for continued activity is the best for many years.

Reports from all jobbers indicate that the holiday season just closed has been the best for many years, one of the leading jobbers stating that his business exceeded that of any holiday season since the war. Vacuum-cleaner sales continue to increase steadily, and manufacturers' representatives report their 1924 business as very satisfactory. The business of one representative has exceeded the previous year's volume by a very comfortable margin with sales in Florida twice as good as in any of the other Southeastern States. Aggressive sales effort is going far to increase the popularity of this specialty, and the outlook for the coming year is very bright. The Christmas demand for radio equipment was very heavy and exceeded the supply in some cases.

Year Closes with Good Buying in the Middle West

BUSINESS in the Middle West continues good. Contrary to expectations, a number of manufacturers report receiving a considerable quantity of equipment orders from utilities. Apparently many budgets for 1924 have not been entirely expended, and the final rush was to utilize previous appropriations. An interesting order for feeder-voltage regulators approximating $125,000 and another for auxiliary equipment were placed this week. Pole-line hardware, cable, cross-arms, and meters were most in demand.

Most of the jobbers are busy with inventory this week. Stock orders for shipment after January 1 are being placed. Most jobbers are entirely satisfied with the volume of business transacted last year. They believe the total volume of business will run better than 25 per cent ahead of 1923. Prices remain generally firm. Firebrick advanced about 5 per cent January 1 and code wire advanced approximately 1½ per cent.

Business on the Pacific Coast Tapered Off Somewhat

BUSINESS on the Pacific Coast has tapered off somewhat. Generally speaking, the past year produced a satisfactory volume of trade, though with decreased profits. In the spring sales were very good, the summer was marked by a more than seasonal slump, but since then there has been a slow recuperation month by month. Natural conditions, such as rainfall, snow storage and crop progress, are unusually promising for a bumper year.

Very good sales are reported by jobbers, with present business quiet while inventories are in progress. Candle sockets and toggle switches have been outstanding items in the past year's sales of schedule material. There has also been a marked increase in the sales of safety switches. Sixteen bids were received by the commissioner of Light and Water at Tacoma, Wash., for the construction of the proposed substation for Lake Cushman. Most of these are below the estimate of $250,000.

Activities of the Trade

Fairbanks-Morse Sales for 1924 Approximate $25,000,000

The sales of Fairbanks-Morse & Company for the year 1924 are expected to approximate $25,000,000, against $26,000,000 in 1923. On present bookings and conservative surveys by branch sales managers it is estimated that 1925 sales will show an increase of 20 per cent over 1924.

Simplex Wire & Cable Company Erecting New Building

A new building is being erected by the Simplex Wire & Cable Company at its plant at Cambridge, Mass. This building will be used partly for expansion of manufacturing activities, but principally for an elaborate high-tension research laboratory where more extensive experimenting and electrical investigation may be carried on.

International Combustion and Vickers Consolidate in Canada

The Canadian subsidiary of the International Combustion Engineering Corporation of New York and the Canadian business of Vickers, Ltd., are to be consolidated and will thereafter be known as the Vickers & Combustion Engineering, Ltd., of Canada. The Vickers plant in Montreal will be ultilized for the full range of engineering work in the Dominion. It is planned to introduce some new lines in the near future.

Arc-Welding Patents Upheld by Court of Appeals

The Circuit Court of Appeals of the District of Columbia has recently rendered a decision awarding to Claude J. Holslag priority of invention over Charles B. Waters on the subpect of alternating-current arc-welding transformers. These inventions are described in the Holslag patents, Nos. 1,305,360 to 1,305,363, which were involved.

The Electric Arc Cutting & Welding Company, the owner of these patent rights, announces that since the decision was handed down it has licensed one company that had been making infringing apparatus. The company further states that it will issue a few more licenses to any reputable companies that desire it.

Bishop Gutta Percha Forms New Corporation

The Bishop Wire & Cable Corporation, organized under New York laws, has acquired the rubber-insulated wire and cable business of the Bishop Gutta Percha Company, 420 East Twenty-fifth Street, New York. The company announces that this change has been made in order to take care of the large increase in its wire business and there will be no change in management. The Bishop Gutta Percha Company will continue to do business, but will manufacture only gutta percha goods at its factory in New York. The Gutta Percha company has been manufacturing insulated wire since 1847.

The new corporation will manufacture practically every type of rubber-insulated wire from the smallest to the very largest cable. It has a modern plant in which practically all new machinery has been recently installed, and will devote it wholly to the manufacture of electric wires and cables.

The Electric Power Equipment Corporation, 412 North Eighteenth Street, Philadelphia, manufacturer of "Elpeco" switching equipment, announces that it has recently made a new connection in the Southwest in appointing the Commercial Electric Company of St. Louis as its agent. The new appointment takes effect on January 15.

The Transelectric Company, Chicago, incorporated on January 1, 1925, is the representative for the Lapp Insulator Company, Transmission Tower Fabricating Company and W. T. Safety Tool Company. The incorporators have been active in the transmission and distribution field for more than six years.

The Wetmore-Savage Electric Supply Company, 76 Pearl Street, Boston, Mass., has been incorporated with a capital of $3,000,000. The incorporators are V. C. Bruce Wetmore, Boston; Karl L. Norris, Saugus, Mass.; Edward W. Wetmore, Newton, Mass., and Clifford C. Perry, Swampscott, Mass.

The Milhender Electric Supply Company, 617 Atlantic Avenue, Boston, will also occupy an adjoining 5-story building beginning February 1.

The W. D. Hamer Company, Indianapolis, reports a very successful year in transmission and distribution equipment, with large placements of orders for spring delivery. The Hamer company represents the Lapp Insulator Company, the Delta Star Company, the Moloney Electric Company, the G. & W. Electric Specialty Company, the Transmission Tower Fabricating Company, the W. T. Safety Tool Company and the Automatic Reclosing Circuit Breaker Company.

The Anaconda Copper Mining Company, 25 Broadway, New York, announces that the new Kenosha wire mill of the American Brass Company has booked for shipment to the Illinois Central Railroad the following Anaconda products: 130 miles hard-drawn grooved copper trolley wire, 105 miles feeder strand and messenger wire and 82 miles grooved "Hitenso" trolley wire.

The Diamond Power Specialty Corporation, Detroit, manufacturer of "Diamond" soot blowers, has appointed the Midwest Machinery Company, 104 South Main Street, St. Louis, as its representative for the territory of Missouri adjacent to St. Louis and for the territory south of and including Springfield and Decatur, Ill.

The Detroit Electric Stove Company, 3435 Piquette Avenue, Detroit, has acquired a plot of ground on the Howard Boulevard, Lincoln Park, a suburb of the city, and has tentative plans under advisement for the erection of a new plant on the site. It is said that two three-story units will be built, each about 75 ft. x 100 ft.

New Equipment Available

Motor-Operated-Valve Mechanism

A motor-operated-valve mechanism known as the "Liberty valve operator" has been placed on the market by the Liberty Electric Corporation, Stamford, Conn. The mechanism is a motor-operated, electrically controlled unit and is made in a range of sizes to suit various service conditions as well as different types and sizes of valves. The unit consists in the main of motor, motor shaft, worm, drive shaft, magnetic clutch, train of gears and limit switch.

Control is accomplished by one or more stations operated either manually or by relays. Indicator lamps show the position of the valve. The valve may also be stopped at any position during travel, and it is said that the mechanism cannot jam or strain the valve. The valve can a'so be hand-operated if desired.

Portable Circular Saw

A portable electric circular saw known as "Skilsaw" has been placed on the market by the Michel Electric Hand Saw Company, 166 East Grand Avenue, Chicago. The device consists of a circular saw properly shielded and containing a guide for the saw mounted on the frame of the motor which drives it. It has a cutting capacity of 2 in. in hard wood and can be used with various attachments for beveling or other purposes. The motor is of the universal type and can be obtained for use on 110 volts or 220 volts. It is equipped with a momentary contact trigger switch to insure safety to the operator.

Conduit Bushing.—A conduit bushing provided with a special ground connection and known as the "Groundit" bushing has been placed on the market by the Groundulet Company, 86 Park Place, Newark. The bushing is provided with a boss that is tapped to receive a soldering stud for connecting a ground wire to it.

Window Reflector.—A new 200-watt window-lighting reflector, known as the No. 944, entirely inclosed so that the lamp filament cannot be seen from any position, has been placed on the market by the Holophane Glass Company, Inc., 342 Madison Avenue, New York. This reflector is said to eliminate glare and back reflections and is of particular value when used in open back windows.

New Trade Literature

SLATE AND MARBLE DRILL.—Bulletin No. 3,018-S, issued by the Hisey-Wolfe Machine Company, Cincinnati, describes and illustrates the "Hisey" electric slate and marble drill.

MOTOR STARTER.—The Monitor Controller Company, Baltimore, is distributing bulletin No. 106, covering its "Thermaload" starter for small alternating-current motors. It contains a table of the ampere rating of the thermal element to be used with induction motors and also instructions for the use and care of the "Thermaload" starter.

SPROCKET WHEELS AND CHAIN BELTING.—The W. A. Jones Foundry & Machine Company, 4401 West Roosevelt Road, Chicago, has issued catalog No. 32, covering its line of sprocket wheels and chain belting, chain tighteners, elevator boots, buckets, hand wheels, etc. It contains illustrations, listing prices and complete specifications on all items shown.

ELECTRIC MOTORS.—The Diehl Manufacturing Company, Elizabeth, N. J., has issued bulletin No. 1,652, containing illustrations showing various industrial and marine applications of Diehl electric motors.

RESISTOR UNITS.—The Ward Leonard Electric Company, Mount Vernon, N. Y., has issued bulletin No. 63 in which it gives an outline of the advance in resistor construction and the development of "Vitrohm" insulation. It also contains a list of the "Vitrohm (vitreous-enameled)" resistor units and various terminals and mountings for same.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purchased is desired in Canada (No. 12,882) of radio sets and parts.

Purchase and agency is desired in France (No. 12,899) for electrical goods.

Purchase and agency is desired in Indo-China (No. 12,881) for fans, electric coiling and desk, all sizes.

Purchase is desired in Ireland (No. 12,883) of radio sets, cabinet and open, two, three and four-valve, and parts.

Purchase and agency is desired in Italy (No. 12,829) for precision and machine tools.

Purchase and agency is desired in Poland (No. 12,880) for radio sets.

Purchase is desired in Australia (No. 12,939) of labor-saving devices, radio sets, etc.

Purchase is desired in Austria (No. 12,878) of radio sets and parts.

Purchase is desired in Uruguay (No. 12,876) of 600 miles of bare and insulated copper wire.

Purchase is desired in Brazil (No. 12,940) of electrical supplies, also radio sets (No. 12,875).

An agency is desired in England (No. 12,914) for electrically operated hoisting and traveling cranes and steam derrick cranes.

An agency is desired in Denmark (No. 12,938) for fireless cookers.

An agency is desired in Germany (No. 12,922) for asbestos fiber and vulcanized fiber for packing and technical purposes.

An agency is desired in India (No. 12,936) for electrical goods.

Agencies are desired in Italy (No. 12,833) for electrical machinery and fittings, insulators, switches, lamp sockets, etc.; (No. 12,831) for machine tools, especially metal-working tools and transmission cables; (No. 12,884) for insulated wires and wiring devices; (No. 12,979) for radio sets and parts.

An agency is desired in Norway (No. 12,909) for a cement refractory as a heat and electrical insulator.

An agency is desired in Switzerland (No. 12,877) for insulating tape.

ELECTRIC EQUIPMENT FOR BOMBAY (INDIA) SUBURBAN RAILWAYS.—Tenders will be received by S. G. S. Young, Secretary of the Bombay, Baroda & Central Railway Company, White Mansion, 91 Petty France, Westminster, S. W. 1, London, England, until Feb. 24, for equipment of manually operated traction substations as follows: (1) For substation and track-sectioning switchgear and accessories; (2) rotary-converter sets; (3) transformers. Alternatively for automatic substations: (4) for substation equipment and track-sectioning switchgear.

LIGHTING STORAGE BATTERIES FOR NEW SOUTH WALES (AUSTRALIA) GOVERNMENT RAILWAYS AND TRAMWAYS.—Tenders will be received by the New South Wales Government Railways and Tramways, Sydney, Australia, until Feb. 11 for two lighting storage batteries.

New Incorporations

THE NORTHERN LIGHT, HEAT & POWER COMPANY, Suring, Wis., has been incorporated by W. R. Cornwell and others, all of Suring. The company is capitalized at $25,000 and proposes to generate and distribute electricity for light, heat and power purposes.

THE PRIEST RIVER (IDAHO) IMPROVEMENT COMPANY has filed articles of incorporation with a capital stock of $25,000 to generate and distribute electricity. The incorporators are: John E. Schaefer, Beecher Hitchcock and George Knippel.

THE CENTRAL STATES UTILITIES COMPANY, Detroit, has been incorporated with a capital of $250,000 by H. M. Eaton, W. S. Thompson and William E. Moss, 8120 Jefferson Avenue, East Detroit.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

DOVER, N. H.—The new street-lighting contract awarded by the City Council to the Twin State Gas & Electric Company provides for replacing the present lighting system in the business district with forty-eight incandescent lamps of 1,000 cp., mounted on ornamental steel poles.

LUDLOW, VT.—The managers of the municipal electric light plant are planning to erect a 2,300-volt transmission line from Ludlow to Plymouth, a distance of 10 miles. Electricity to operate the municipal plant is supplied by the Vermont Hydro-Electric Corporation, Rutland.

Middle Atlantic States

BINGHAMTON, N. Y.—The Public Service Commission has granted the Binghamton Light, Heat & Power Company permission to extend its transmission and distribution system to operate in twenty-six municipalities in Broome, Chenango, Cortland and Tioga Counties. In some of the communities covered by the order there are no existing lighting facilities. In a number of the towns the systems have already been transferred to the Binghamton Company.

BROOKLYN, N. Y.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 6 for furnishing electric wire and cable, brass and copper pipe and tubing, searchlight carbons, fuses and fuse elements, etc., to the Navy Supply Depot, South Brooklyn, N. Y.

FULTON, N. Y.—The New York Canners, Inc., is reported to be planning the installation of electric power equipment in connection with the proposed rebuilding of its plant, recently destroyed by fire, with a loss of about $450,000.

JAMESTOWN, N. Y.—Plans are under consideration by the City Council for the installation of a combined police and fire-alarm telegraph system, to replace the present separate system.

JAMESTOWN, N. Y.—The installation of electrically operated pumps in the proposed sewage purification plant, to cost about $125,000, is under consideration. Melvin O. Swanson is superintendent of Department of Public Works.

NEW YORK, N. Y.—Extensions involving an expenditure of $41,500,000 have been announced by the North American Company, 60 Broadway. Plans for the northern Ohio district surrounding Cleveland call for expenditures of $20,000,000 in 1925. The work will include the new 400,000-hp. station at Avon, near Cleveland, which is designed to supplement facilities of the Cleveland plant. A new steam plant for supplying steam heat will be built in Cleveland and many important extensions will be made to the company's distribution lines. In the Illinois-Missouri territory centering in St. Louis the program calls for extensions to cost about $11,000,000. In Wisconsin and Michigan $10,000,000 will be spent, while in Kentucky the plans for improvements on electric properties will total $500,000.

POUGHKEEPSIE, N. Y.—Plans are under consideration by the Board of Aldermen for installing a new street-lighting system to replace the arc lamps now in use. It is proposed to install incandescent lamps of 600 cp. The Central Hudson Gas & Electric Company has the contract for street lighting.

ROCHESTER, N. Y.—The Rochester Gas & Electric Company plans to erect a central steam-heating plant, to cost about $1,000,000.

SCHUYLERVILLE, N. Y.—The Standard Wall Paper Company, Hudson Falls, N. Y., contemplates installing electric power equipment in connection with the proposed rebuilding of its local mill, recently damaged by fire with loss of about $500,000.

BROWN'S MILLS, N. J.—The Eastern New Jersey Power Company, Allenhurst, contemplates rebuilding the local power plant, recently acquired. Extensions in transmission lines will be made.

HARRISON, N. J.—The Public Service Electric & Gas Company, Newark, it is reported, has inquiries out for structural steel for a new steam-operated power station in Harrison.

MONESSEN, PA.—Improvements are contemplated to the street-lighting system during 1925, to cost about $20,000.

SELLERSVILLE, PA.—The Council is considering the installation of an improved street-lighting system in the business district. The work will be carried out by the Pennsylvania Power & Light Company.

DAMASCUS, MD.—The Damascus Light & Power Company has been granted permission by the Public Service Commission to erect a transmission line from Ridgefield to Damascus.

HAGERSTOWN, MD.—The court injunction restraining the city from proceeding with the construction of a municipal electric light and power plant has been dissolved.

BELINGTON, W. VA.—Bonds to the amount of $38,000 have been voted to take over the local electric light plant and waterworks system.

SALTVILLE, VA.—The Mathieson Alkali Works, Inc., 25 West Forty-third Street, New York, plans to install electric power equipment in proposed additions to its local plant, to cost about $750,000.

North Central States

BOYNE CITY, MICH.—Plans for the proposed cement plant to be erected by the Boyne City Portland Cement Company in the Pine Lake section, to cost about $1,250,000, include a power plant. W. H. White, Boyne City, is interested in the project.

CALUMET, MICH.—Plans for the rebuilding of the local fertilizer and glue plant of the United Chemical Products Company, recently damaged by fire, include the installation of electric power equipment. The loss is estimated at $500,000.

IRON MOUNTAIN, MICH.—Plans are under consideration for the installation of an ornamental street-lighting system in the business section.

KALAMAZOO, MICH.—The Saniwax Paper Company, 4148 North Park Street, plans to install electric power equipment in its proposed local plant, to cost about $150,000. Le Roy & Newlander, Pratt Building, are architects.

MONROE, MICH.—The Detroit Edison Company is negotiating for the purchase of the River Basin Hydro-Electric Company, with transmission lines extending for about 30 miles in this district, including Maybee and Scofield. If taken over, the Detroit company plans additional transmission lines throughout this section.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until Jan. 9 for economizers for the Division of Light and Power.

NELSONVILLE, OHIO.—The Hocking Power Company has secured franchises in the Pomeroy Bend and Jackson County

sections and plans extensions to its transmission lines. The company is also negotiating for a franchise at Wellston City.

TOLEDO, OHIO. — The Toledo Edison Company is asking bids for the structural steel framework for an addition to its local electric power plant.

CAWOOD, KY.—The Kentucky Utilities Company, Louisville, contemplates the construction of a transmission line between Cawood and Black Star, to be used primarily for power service for mining operations.

EVANSVILLE, IND. — The Chicago & Eastern Illinois Railroad Company, 332 South Michigan Avenue, plans the installation of electric power equipment at its proposed local shops and freight terminal. The cost is estimated at about $1,500,000.

INDIANAPOLIS, IND. — The National Biscuit Company, Pine and Daly Streets, contemplates extensions in the power house at its local plant.

CHICAGO, ILL. — The Glass Novelty Company, Inc., 1500 Blue Island Avenue, contemplates the installation of electric power equipment at its proposed plant at Twenty-sixth and Kostner Streets, to cost about $400,000. Sidney H. Minchin, 140 South Dearborn Street, Chicago, is architect.

DURAND, ILL.—The plant and system of the Citizens' Utilities Company, which provides electricity here and in the towns of Rock City, Davis and Dakota, has been acquired by the Beloit (Wis) Gas & Electric Company. The latter company will continue the service and will connect with several other towns.

MANITO, ILL. — The Central Illinois Light Company, Springfield, has acquired the municipal electric power plant and will furnish service in the future from its transmission system.

SUPERIOR, WIS.—The City Council is considering a petition for the installation of an ornamental lighting system on East Fifth Street. E. B. Banks is city engineer.

GRANITE FALLS, MINN. — The City Council has issued $30,000 in bonds, the proceeds to be used for extensions and improvements in the municipal electric plant and waterworks.

OWATONNA, MINN.—Plans are under way by the Interstate Power Company, Chicago, for the erection of a 66,000-volt transmission line between Owatonna and Albert Lea. Electricity will be supplied to Geneva, Clark's Grove, Ellendale, Hope and Blooming Prairie and to farms along the line. The company also contemplates rebuilding its transmission line between Albert Lea and Lake Mills, Iowa, increasing the voltage from 13,000 to 33,000.

ST. CLOUD, MINN.—The City Council plans the installation of electrically operated pumping machinery, etc., in connection with a proposed fountain drinking system in Central Park. A. W. Buckman is city clerk.

BRITT, IOWA. — The Britt Light & Power Company has applied for permission to erect transmission lines on a number of highways in Kossuth County.

GRINNELL, IOWA. — Many improvements are contemplated to the local plant, which has been taken over by the Iowa Southern Utilities Company, Centerville.

SAC CITY, IOWA.—Russell & Fry plan to construct an electric light and power plant in Sac City for industrial service.

STRATFORD, IOWA.—Plans are being considered for rebuilding the distribution system of the Stratford Electric Light & Power Company, at a cost of about $4,000.

ST. LOUIS, MO.—The St. Louis-Kansas City Short Line Railroad Company, recently incorporated, plans to build an electric railroad from St. Louis to Kansas City, a distance of 238 miles. L. Dunlap, 3524 Morrell Avenue, Kansas City, is one of the incorporators.

TURTON, S. D.—Bonds to the amount of $10,000 have been voted for the installation of an electric lighting system.

OBERT, NEB.—The City Council has granted the Minnesota Electric Distributing Company, Minneapolis, a franchise to furnish electricity in Obert. The proposed transmission line will also furnish service in Wynot, Fordyce, Hartington and Newcastle.

Southern States

WELDON, N. C. — The Grant Brick Works are planning to install three outdoor-type transformers of 75 kva. capacity and other electric equipment.

CLINTON, S. C.—A bond issue of $15,000 is being arranged for the installation of an ornamental lighting system on principal streets in the downtown district.

HIALEAH, FLA. — The South Florida Cold Storage & Ice Company, Miami, recently organized, plans to install electric power equipment in its proposed local cold-storage and ice-manufacturing plant, to cost $1,000,000. George C. Hyde is engineer.

CHATTANOOGA, TENN.—The Cumberland Telephone & Telegraph Company, Nashville, contemplates extensions to its telephone lines and cables around Chattanooga, to cost about $200,000.

MEMPHIS, TENN.—Plans are under consideration for improvements to the lighting system in the business district during 1925, to cost about $65,000.

FAIRFIELD, ALA.—The Fairfield First Addition, Inc., recently organized, plans to install a lighting system to cost about $15,000, on a tract of land lately purchased for development. Walter Schoel, Title Building, Birmingham, is engineer.

SELMA, ALA. — The Alabama Power Company is considering the erection of an additional transmission line from its station on the Coosa River to this place.

SYLACAUGA, ALA.—The installation of an ornamental lighting system, consisting of fifty-five units, is under consideration by the City Council.

BALD KNOB, ARK.—Plans are under consideration by Campbell & Richardson to rebuild their electric light plant, recently destroyed by fire.

DANVILLE, ARK.—The Danville Electric Company plans to rebuild its power plant, recently damaged by fire.

PINE BLUFF, ARK.—The construction of a powder dam on Piney Creek in Johnson County, to cost about $986,000, is under consideration by the Arkansas Light & Power Company.

CONROE, TEX. — The Western Public Service Company has acquired the local electric light and power and ice plants and plans extensions in its transmission system. The company, it is reported, contemplates the construction of a new central station to furnish electricity in this section.

CORSICANA, TEX.—The construction of a transmission line from Corsicana to the Wortham oil field is under consideration by the Texas Power & Light Company, Dallas.

DALLAS, TEX.—All bids for the installation of an ornamental lighting system on Jefferson and Lancaster Avenues in Oak Cliff have been rejected by the City Commission.

EL CAMPO, TEX.—The Texas Central Light & Power Company, San Antonio, has acquired the property of the Central Service Company and plans to extend its transmission line here. Additions to the local system are under consideration.

McALLEN, TEX.—Bids will be received by H. P. Smith, architect, National Bank of Commerce, San Antonio, until Jan. 10 for construction of administration building, two dormitories and power house for the Baptist College Church, to cost about $250,000.

Pacific and Mountain States

BELLINGHAM, WASH.—The Whatcom County Power & Light Company is planning to erect a 6,600-volt transmission line on the Northwest Road and Rural Avenue.

CENTRALIA, WASH.—The City Commissioners have authorized the Mayor and city clerk to make application to the Commissioners of Lewis County for a franchise to erect and operate a transmission line up the Salzer River for light and power service.

SPOKANE, WASH. — The Washington Water Power Company has applied to the Federal Power Commission for permission to erect a transmission line 3.21 miles long in Shoshone County, Idaho.

WALLA WALLA, WASH.—The Pacific Power & Light Company, Portland, contemplates improvements and extensions to its system in the Walla Walla and adjacent district during the coming year, to cost about $107,000. The work includes the erection of a new electric transmission line to serve College Place and Prospect Heights. New equipment will be installed in the Walla Walla substation, including new underground feeder cables and transformer for 6,600 volts and reconstruction of lines throughout the city.

WICKERSHAM, WASH.—A permit has been granted the Wickersham Light & Power Company for the use of water from Ennis Creek to develop power for light and power purposes to be distributed in Wickersham and adjacent farming territory. The cost of the pipe line and dam is estimated at $3,000.

BISHOP, CAL. — The Hillside Water Company has applied to the Federal Power Company for a license to construct four storage reservoirs on the North and Middle Forks of Bishop Creek in Inyo County for the purpose of augmenting the supply of water available for the irrigation of lands located on the lower reaches of Bishop Creek and for generating hydro-electric power through Bishop Creek plants Nos. 2, 3, 4, 5 and 6 of the Nevada-California Power Company and the Southern Sierras Power Company. The plans provide for the development of 700 hp.

LOS ANGELES, CAL.—The construction program of the Los Angeles Gas & Electric Corporation calls for an expenditure of $12,360,000. Of this amount $3,516,000 will be used for improvements to the electric distribution system and $1,000,000 for a new plant site.

OAKLAND, CAL.—The City Council is considering the installation of an electric light system for traffic regulation on streets in the downtown district, estimated to cost $12,800. W. W. Harmon is city engineer.

OAKLAND, CAL.—The Board of Alameda County Supervisors will soon ask bids for the construction of a steam-driven power plant at Fourteenth Avenue and East Twenty-seventh Street, to cost about $200,000. H. H. Meyers, Kohl Building, San Francisco, is engineer.

ORANGE, CAL.—The City Council has adopted resolutions providing for the installation of ornamental lamps on West Chapman Avenue from the Santa Fe tracks to Main Street and on North Center from Chapman to Sycamore Street.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has applied to the Federal Power Commission to erect a transmission line, 2.40 miles long, extending from its Hell Hole power plant to the transmission line of the Southern Sierras Power Company, near Rincon.

SAN FRANCISCO, CAL. — Application has been made to the Federal Power Commission by the California Oregon Power Company for a license to erect a transmission line, 77½ miles long, in Siskiyou and Shasta Counties.

TURLOCK, CAL. — Plans have been adopted by the City Trustees for the installation of an electrolier lighting system.

LEWISTON, IDAHO.—The city of Lewiston has applied for a preliminary permit for a hydro-electric plant on Clearwater River, near Lewiston. The project includes the construction of a 30-ft. dam and power house to develop 2,500 hp.

SALT LAKE RIVER, UTAH. — Plans have been completed by the Utah Power & Light Company for the construction of a third hydro-electric development on the Bear River, to be known as the Cutler plant. The proposed plant will be equipped with two 15,000-kw. generating units operating under an effective head of 128 ft. The project includes a 110-ft dam and will cost about $5,500,000. A third 130-kv. transmission line, 80 miles, will be erected from the new plant to Salt Lake City.

BUTTE, MONT.—Application has been made to the Federal Power Commission by the Montana Power Company for a license to erect a transmission line, 26.7 miles long, in Stillwater and Cargon Counties, crossing the Beartooth National Forest.

Canada

ST. BONIFACE, MAN.—Plans are under consideration by J. D. McArthur, Winnipeg, for the construction of a large pulp and paper mill in St. Boniface. About $2,000,000, it is reported, will be expended on a transmission line and electrical equipment for the project. Apparatus required will include 400 miles of copper wire, 1,000 steel towers, 6,000 insulators and two new turbines, etc.

SARNIA, ONT. — The Hydro-Electric Power Commission of Ontario, Toronto, has acquired a site on which it proposes to build a transformer and distribution station, to cost from $50,000 to $100,000.

ST. LAMBERT, QUE.—The installation of a 22,000-volt transformer and switching apparatus for 1,500 kva. capacity is under consideration by the City Council. J. A. Burnett, Montreal, is consulting engineer.

THREE RIVERS, QUE. — The North Shore Power Company has filed application with the Public Service Commission asking permission to erect a 25,000-volt transmission line from the Planet Falls development at St. Raymond.

Electrical Patents

Announced by U. S. Patent Office

(Issued December 2, 1924)

,517,857. SELECTIVE SYSTEM; Philander Norton and David T. May, Port Washington, N. Y. App. filed Dec. 29, 1923. Selective operation of electro-responsive devices, as telephone ringers, relays, etc.

1,517,866. PROCESS FOR REGULATING THE SPEED OF AN ELECTRIC MOTOR CASCADE; Walter Seiz, Baden, Switzerland. App. filed June 27, 1921.

1,517,869. SEMIAUTOMATIC TELEPHONE-EXCHANGE SYSTEM; Ray L. Stokely, Floral Park, N. Y. App. filed Nov. 4, 1921.

1,517,920. PRESS-BUTTON SWITCH; Hugo Sachs, Leipzig, Germany. App. filed July 15, 1920.

1,517,938. ELECTRIC FURNACE; Theodore B. Bechtel, Philadelphia, Pa. App. filed Dec. 12, 1922. Resistor type.

1,517,953. ATTACHMENT PLUG; Hoyt Catlin, Bridgeport, Conn. App. filed March 26, 1920.

1,517,981. FUSE; Archibald Grieve, Westport, Conn. App. filed May 5, 1921. Renewable cartridge clip type.

1,518,013. ELECTRICAL APPARATUS; Frank F. Starr, Dayton, Ohio. App. filed Sept. 26, 1923. Control apparatus for a motor.

1,518,020. ELECTROMAGNET; Oliver C. Traver, Schenectady, N. Y. App. filed July 26, 1921. With reduced residual magnetism and with chattering of the armature prevented.

1,518,041. ELECTRIC SWITCH; Charles E. Avery, East Orange, N. J. App. filed Nov. 17, 1922. Wall switch of the quick-break type.

1,518,042. TOGGLE SWITCH; Charles E. Avery, East Orange, N. J. App. filed Nov. 20, 1922.

1,518,056. CALLING DEVICE; Henry E. Elrod, Dallas, Tex. App. filed April 8, 1921. Employed in automatic and semi-automatic telephone systems.

1,518,067. ELECTRIC HEATER; William W. Hicks, San Francisco, Cal. App. filed July 17, 1922. Wall type.

1,518,084. HOLDER; William H. Lovelace, Daina, Ky. App. filed July 28, 1923. Electrode holder.

1,518,085. ELECTRIC HEATER FOR STEERING WHEELS; Walter W. McDowell, Kiefer, Okla. App. filed Feb. 4, 1924.

1,518,104. ELECTRIC HAMMER; Ennio Polidori, Curzio Polidori and Emidio Polidori, Rome, Italy. App. filed Jan. 16, 1922.

1,518,123. EXCITING MEANS FOR ELECTRODYNAMICAL OSCILLATORS; Harry P. Lawther, Jr., Dallas, Tex. App. filed Aug. 29, 1918. To produce compressional waves employed in submarine signaling.

(Issued December 9, 1924)

1,518,137. ELECTRIC SYSTEM FOR LOCOMOTIVES; Sidney W. Farnham, Chicago, Ill. App. filed Dec. 22, 1922.

1,518,164. MAGNETIC MOTOR; Charles C. Powers, Big Creek, Cal. App. filed Feb. 27, 1924.

1,518,168. TROLLEY WHEEL; Adrian C. Van Hooydonk, Monroe, Mich. App. filed Aug. 11, 1922.

1,518,196. INDUCTION ELECTRICITY METER; Jesse Harris, Lafayette, Ind. Watt-hour meter.

1,518,209. MACHINE FOR WINDING LOOSE COILS FOR ARMATURE AND THE LIKE; Claude M. McCord, Richmond Heights, Mo. App. filed April 17, 1924.

1,518,214. RECORDING MECHANISM; William B. Murray, Danville, Ill. App. filed Aug. 12, 1918. For use in connection with train-control apparatus.

1,518,273. ELECTRIC HAMMER; Louis Paulero, Petersburg, Va. App. filed March 30, 1920.

1,518,301. DRY BATTERY; Raymond C. Benner and Harry F. French, Fremont, Ohio. App. filed Oct. 3, 1919. Deferred-action type.

1,518,317. STRIKING MECHANISM FOR ELECTRIC CLOCKS; Maurice Philippe Favre-Bulle, Paris, France. App. filed Aug. 21, 1923.

1,518,332. ELECTRIC METER; August J. Kloneck, New York, N. Y. App. filed Aug. Aug. 16, 1920. Combination voltmeter, ammeter or frequency meter.

1,518,335. TELEPHONE-CIRCUIT-TESTING APPARATUS; JOHN W. MCNICOL, Urbana, Ohio. App. filed Feb. 14, 1921.

1,518,383. SWITCH MECHANISM; Reuben B. Benjamin, Chicago, Ill. App. filed June 2, 1919. Applicable to lamp sockets, etc.

1,518,401. MULTIPLEX TRANSMISSION OF MESSAGES BY HIGH-FREQUENCY OSCILLATIONS; Heinrich Fassbender, Charlottenburg, Germany, and Erich Habann, Berlin, Germany. App. filed May 3, 1921.

1,518,416. ELECTRODE-COOLING CONSTRUCTION; Harry M. St. John, Detroit, Mich. App. filed Oct. 10, 1922.

1,518,436. ELECTRICAL CONNECTER DEVICE; Arthur P. Leinen, Chicago, Ill. App. filed Feb. 27, 1922. Two-way plugs.

1,518,439. ARC TRANSMITTER FOR WIRELESS TELEGRAPHY; Alexander Meissner, Berlin, Germany. App. filed Sept. 3, 1921.

1,518,440. BALANCING CIRCUIT FOR TELEPHONIC TRANSMISSION; Alexander Meissner, Berlin, Germany. App. filed May 3, 1922.

1,518,460. COMBINATION TEST CLAMP; Arthur C. Smith, Meriden, Conn. App. filed March 6, 1922. For use on telegraph or telephone wires.

1,518,495. SELECTIVE CIRCUITS; Lloyd Espenschied, Hollis, N. Y. App. filed Sept. 26, 1919. Multiplex transmission.

1,518,530. ELECTRIC LAMP; Clarence Lipper, Philadelphia, Pa. App. filed Aug. 23, 1922. Dry-cell-operated, portable type.

1,518,539. CROSSING SIGNAL; Will C. Neahr, Denver, Col. App. filed Nov. 28, 1916. For railroad crossings.

1,518,543. ELECTRICAL MEASURING APPARATUS; Harry Nyquist, Elmhurst, N. Y. App. filed Oct. 28, 1921. For determining the presence of harmonics in a circuit.

1,518,564. RADIO TELEPHONE AND TELEGRAPH APPARATUS; Theodore S. Cole, New Haven, Conn. App. filed Oct. 27, 1922. Storage battery.

1,518,575. FOCUSING HAND SEARCHLIGHT; Richard M. Eaton, Niagara Falls, N. Y. App. filed Dec. 24, 1921.

1,518,591. MAGNETO; Samuel C. McKeown, Newark, N. J. App. filed Jan. 17, 1921.

1,518,592. CONTROL OF INDUCTION MOTORS; Robert H. McLain, Schenectady, N. Y. App. filed Jan. 12, 1921. To operate at a maximum number of substantially definite speeds.

1,518,609. APPARATUS TO FACILITATE THE REMOVAL OF STARTING-SHEET DEPOSITS FROM THEIR RECEIVING BLANKS; Frank J. Sibol, Perthy Amboy, N. J. App. filed April 1, 1922. In the electrolytic refinement of copper.

1,518,612. ALTERNATING-CURRENT ELECTROMAGNET; Harry M. Stevens, Schenectady, N. Y. App. filed Oct. 7, 1921.

1,518,619. SYSTEM OF MOTOR CONTROL; Alfred F. Welch, Fort Wayne, Ind. App. filed March 31, 1922. In response to temperature changes, pressure changes, etc.

1,518,624. 1,518,625. AMPLIFYING SYSTEM; William C. White, Schenectady, N. Y. App. filed July 8, 1919. In which a plurality of amplifiers are connected in parallel.

1,518,633. RADIO SIGNALING SYSTEM AND APPARATUS THEREFOR; Rupert E. H. Carpenter, Purley, England. App. filed May 20, 1924.

1,518,637, 1,518,638. DRY CELL; Harold De Olaneta, New Haven, Conn. App. filed Dec. 22, 1919.

1,518,639. CORD CONNECTER; Frank C. De Reamer, Schenectady, N. Y. App. filed Jan. 10, 1921.

1,518,655. RADIO-TELEGRAPH SYSTEM; Wendell L. Carlson and Earl C. Hanson, Washington, D. C. App. filed Jan. 14, 1920.

1,518,682. SIGNALING SYSTEM; Walter R. G. Baker, Schenectady, N. Y. App. filed Nov. 6, 1923. Using vacuum-tube high-frequency generators.

1,518,683. SIGNALING SYSTEM; Walter R. G. Baker, Schenectady, N. Y. App. filed Nov. 6, 1923. In which high-frequency signaling currents are transmitted over high-potential electric transmission lines.

1,518,701. QUICK-ACTING-SWITCH MECHANISM; Ralph Penn, Des Moines, Iowa. App. filed Dec. 10, 1923.

1,518,733. CONNECTER; Reuben Eckstein, New York, N. Y. App. filed April 14, 1921. Attachment-plug type.

1,518,736. TELEPHONE SYSTEM; Charles L. Goodrum, New York, N. Y. App. filed Dec. 2, 1920. Adapted for paging or dictating purposes.

1,518,792. AUTOMATIC CONTROL OF OIL DEHYDRATORS; Edward J. Hunt, West Orange, N. J. App. filed Nov. 4, 1921.

1,518,795. ELECTRIC CONNECTOR; Joseph S. Jones, Brooklyn, N. Y. App. filed Oct. 9, 1922. Plugs used in telephone switchboard circuits.

1,518,814. ELECTRIC BATTERY; Samuel B. Pack, Washington, D. C. App. filed Nov. 18, 1919. Storage battery.

1,518,815. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; Lipa Polinkowsky, Hyde Park, London, England. App. filed Dec. 28, 1918.

1,518,862. OVERFLOW TRUNKING SYSTEM; Clarence E. Lomax, Chicago, Ill. App. filed Dec. 6, 1921. For automatic telephone systems.

1,518,888. SWITCH; Frederick O. Winklehaus, New York, N. Y. App. filed July 7, 1922. Snap switch.

1,518,952. ELECTRIC MOTOR WITH SQUIRREL-CAGE ROTOR; Armais Arutunoff, Berlin, Germany. App. filed July 14, 1922. With resistance of rotor automatically increased by centrifugal means during starting or on reduction of speed.

1,518,957. ELECTRIC SWITCH; Bernhart A. Benson, Chicago, Ill. App. filed March 29, 1924. Pull or push type.

1,518,979. THERMOSTATIC CIRCUIT CLOSER; Nat H. Freeman, Holborn, London, England. App. filed Sept. 2, 1921.

1,519,007. WELDING BY THE ELECTRIC ARC; John H. Paterson, Westminster, London, England. App. filed Nov. 27, 1922.

1,519,044. ELECTRIC SWITCH; Henry T. Paiste, Philadelphia, Pa. App. filed July 31, 1920. Safety type.

1,519,058. PROCESS OF MELTING METALS; Wilhelm Rohn, Hanau, Germany. App. filed Sept. 22, 1921. Using induction furnaces.

1,519,059. ELECTRIC SWITCH; Percy Russell. Swarthmore, Pa. App. filed July 29, 1921. Multi-point switch.

1,519,061. ELECTRIC SWITCH; Adolph W. Schramm, Riverton, N. J. App. filed July 13, 1921. Rotating blade multi-contact type.

1,519,062. ELECTRIC WELDING AND HEATING DEVICE; Edmund Schroder, Berlin, German. App. filed April 3, 1922.

1,519,063. ELECTRIC SEAM-WELDING MACHINE; Edmund Schroder, Berlin, Germany. App. filed May 22, 1922.

1,519,089. KNIFE SWITCH; Benjamin E. Getchell, Plainville, Conn. App. filed July 8, 1922.

(Issued December 16, 1924)

1,519,098. ALTERNATING-CURRENT METER; Leopold Adert, Berlin, Germany. App. filed Aug. 10, 1920. Watt-hour meter.

1,519,108. COUPLING FOR ARMORED CABLES; Lloyd A. Brooke, Landover, Md. App. filed July 5, 1923.

1,519,148. STREET OR STATION INDICATOR; John McCall, Toronto, Ontario, Canada. App. filed July 12, 1924. For vehicles.

1,519,195. CONNECTING DEVICE FOR ELECTRIC CIRCUITS; Samuel M. Esler, Marion, Ind. App. filed Aug. 7, 1919. Multiple plug.

1,519,202. TELEGRAPH SYSTEM; Joseph Herman, New York, N. Y. App. filed Feb. 20, 1922. Duplex.

1,519,211. LOUD-SPEAKER CIRCUITS; William H. Martin, New York, N. Y. App. filed June 17, 1922. Telephone circuits suitable for use with loud-speaker apparatus.

1,519,222. ELECTRIC MOTOR; George I. Seiss, Toledo, Ohio. App. filed March 1, 1923. Shell inclosed as used in a signal horn.

1,519,229. SNAP SWITCH; Christian Aalborg, Pittsburgh, Pa. App. filed Aug. 17, 1920. Toggle type.

1,519,230. CIRCUIT INTERRUPTER; Christian Aalborg, Wilkinsburg, Pa. App. filed July 10, 1918. With arc-blow-out device.

1,519,234. HEATER CONTROL; Rudolph A. Bolze, Pleasantville, N. Y. App. filed Oct. 2, 1919. Thermostatically operated.

1,519,238. MOTOR-CONTROL SYSTEM; John A. Clarke, Jr., Edgewood Park, Pa. App. filed June 25, 1921. To govern the operation of railway motors that are subjected to comparatively high voltages.

1,519,246. ELECTRIC SOLDERING IRON; Frank F. Forshee, Flint, Mich., and James C. Woodson, Mansfield, Ohio. App. filed Oct. 20, 1921.

1,519,254. CONTROL SYSTEM; Walter L. Hartzell and George W. Huey, Wilkinsburg, Pa. App. filed Oct. 18, 1920. For motors employed under widely different operating conditions, as in the operation of oil wells.

1,519,255. MOTOR-CONTROL SYSTEM; Albert L. Harvey, Wilkinsburg, Pa., and David H. Hunter, Pittsburgh, Pa. App. filed Oct. 9, 1920. For starting induction and synchronous motors.

1,519,257. MOTOR-CONTROL SYSTEM; Rudolf E. Hellmund, Swissvale, Pa. App. filed Jan. 8, 1920. For induction motors of relatively large capacity.

1,519,258. TRANSFORMER; William G. Hettich, Chicago, Ill. App. filed Jan. 22, 1920. For use with X-ray tubes.

1,519,266. SIGNAL LAMP; Millard F. Roebling, Cincinnati, Ohio. App. filed Sept. 2, 1919. Portable.

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Printed in the First Issue of Each Volume

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Financial and Corporate

Utility Stocks Jump

Smart Advances Carry Many Groups to New Peaks as the Old Year Passes

IN WHAT was one of the most buoyant market periods of 1924 power and light stocks during the last week of the old year made spectacular advances to new high prices for all time. Following Christmas the accumulation of stocks was pretty general in many prominent groups despite the prediction in some quarters that the last week of the year might bring a dull and reactionary market.

American Water Works & Electric Company's stock was the one among the listed issues to make the most conspicuous rise, that issue having crossed 41, or the equivalent of 205 for the old stock that sold earlier in 1924 at 40. Perhaps in the actual number of points added National Power & Light made the most spectacular gain. From 207 for the week before this stock got to 256 in a rapid run-up. Commonwealth Power Corporation's shares again were under wide accumulation, but little stock was offered as the bid was raised, and from 126 for the week before the stock rose to a fresh "high" in its history at 135, a price that compares with 50 for earlier in the year. Lehigh Power Securities, which in recent weeks has held around par, established a new peak at 119. American Gas & Electric sold up to 130.

Electric Investors, Inc., among the lower-priced issues, turned especially popular in the last week of the year, the price of the stock rising to 48 as compared with the recent price of 35. Electric Investors, Inc., warrants have been traded in by the thousand and within ten days have moved from 15 to 29. The American Superpower stocks also have been under heavy accumulation.

Interstate Corporation to Control Staten Island Edison

The New York-New Jersey Superpower Connecting Corporation, organized under the laws of New Jersey, has made application to the New York State Public Service Commission for consent to acquire and hold 10,000 shares of cumulative preferred capital stock and all or any part of the common capital stock of the Staten Island Edison Corporation. The Superpower Connecting Corporation was organized to engage in the manufacture, purchase, distribution and transmission of electricity and financing and construction of transmission lines for the interchange of power between corporations in New York and New Jersey. The petition states that the superpower corporation proposes to contract with the Staten Island corporation for the interchange of power and that the full development of the plan, because of the large sums involved, makes desirable a mutuality of ownership as well as of interest.

Since the formation two years ago of the Staten Island Edison Corporation as a reorganization of the Richmond Light & Railroad Company the electrical output has increased from 36,592,800 kw.-hr. to 57,023,400 kw.-hr. per year, an increase of 56 per cent, it is asserted in the petition. The company has contracted to furnish the Staten Island Rapid Transit Railway with 17,000,000 kw.-hr annually on the completion of its electrification. This will increase the corporation's load, the petition states, to a point where it will be necessary to find other sources of power. The petition sets forth that the most likely sources are in New Jersey and to the west, where there are in service or construction large central-station plants at tidewater.

General Electric Announces New Policy

Will Relinquish Its Ownership of Electric Bond & Share Stock and Turn Over Its Holdings, by Means of a New Company, to Its Stockholders

ADVANCE rumors of an important change in the relationship of the General Electric Company to the Electric Bond & Share Company received confirmation on Tuesday afternoon of this week, when the former company announced half an hour before the closing of the New York Stock Exchange that it would dispose of its holdings in the Electric Bond & Share Company, the common stock of which it owns entirely. The Electric Bond & Share Company supervises the finances and operation of about 150 electric power, street-railway and gas companies having a combined capitalization in the hands of the public of more than $750,000,000 and serving a population of 7,500,000.

OFFICIAL NOTICE TO STOCKHOLDERS

The official announcement, made public after a meeting of the directors on Tuesday, was as follows:

"DECEMBER 30, 1924.

"To the Stockholders of the General Electric Company:

"The General Electric Company, having decided to dispose of all of its share holdings in the Electric Bond & Share Company, will do so by organizing a new corporation under the laws of the State of New York, with an authorized capital stock of 1,802,870 shares without par value (being the same number of shares as the outstanding common stock of the General Electric Company), and by transferring to such new corporation:

"(a) Three hundred shares of the 6 per cent cumulative preferred stock of the Electric Bond & Share Company, having a par value of $30,000, and

"(b) Two hundred and fifty thousand shares of the common stock of the Electric Bond & Share Company (being the entire common stock), having a par value of $25,000,000 and now paying dividends at the rate of 8 per cent per annum.

"The new corporation, in consideration of such transfer, will distribute its shares to the stockholders of record of the General Electric Company as of January 15, 1925, ratably in proportion to their holdings; that is to say, one share of stock of the new corporation to each General Electric share. This distribution will be made on February 1, 1925, or as soon thereafter as the necessary legal steps can be taken, when certificates for shares of the new corporation will be mailed to all stockholders of General Electric Company.

"Dividends on the new stock will accrue after January 1 and will be paid quarterly by the new corporation on the fifteenth days of April, July, October and January. The present rate of dividend on the Electric Bond & Share stock will justify the new corporation in paying dividends of not less than $1 per share per annum.

"By order of the Board of Directors.

"OWEN D. YOUNG, Chairman.

"GERARD SWOPE, President."

EXPLANATORY STATEMENT

The following explanatory statement was issued after the meeting by Chairman Owen D. Young and President Gerard Swope of the General Electric Company:

"At the beginning of the electrical industry in the United States, for the purpose of promoting its growth and development and of rendering electric service available to the different communities, it was necessary to assist in the establishment of electrical public service enterprises, not only in respect to engineering involved in construction, but particularly in rendering aid in financing the capital requirements of such undertakings. The General Electric Company and its predecessor companies—the Thomson-Houston Electric Company and the Edison General Electric Company—under the farseeing and courageous leadership of C. A. Coffin, were active in this field.

"In order to co-ordinate these activities and render its assistance to the industry more effective, the management of investments of this character was concentrated principally in the

Stock and Bond Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stocks is $100.

Companies	Bid Price Saturday, Dec. 27	Low 1924	High 1924
PREFERRED STOCKS			
Operating Companies			
Adirondack Power & Light 7 per cent	a 99	94	99
Appalachian Power, 7 per cent	a 93	85½	93
Arkansas Light & Power 7 per cent	a 94	81	96
Asheville Power & Light 7 per cent	a 95	95	99
Central Illinois Public Service 6 per cent	a 85	84	88
Colorado Power 7 per cent	a 92	90	98
Connecticut Light & Power 7 per cent	a105	99	106
Consumers' Power 6 per cent	a 90	85	93
Dayton Power & Light 6 per cent	a 88	84	101
Duquesne Light 7 per cent	a105	102	108½
Eastern Texas Electric 6 per cent	a 99	81	105
Empire District Electric 6 per cent	a 70	70	78
Fort Worth Power & Light 7 per cent	a 99	97	103
Great Western Power 7 per cent	98	96	99
Illinois Northern Utilities 6 per cent	86	82	87
Illinois Power & Light 7 per cent	a 92	84	95
Kansas Gas & Electric 7 per cent	a 94	92	97
Long Island Lighting 7 per cent	97	95½	102
Minnesota Power & Light 6 per cent	87	78	90
Mississippi River Power 6 per cent	a 88	80	90
Nebraska Power 7 per cent	96	89	99
Niagara Falls Power—25	a 28½	27	29
Niagara, Lockport & Ont. Power 7 per cent	a101½	99	107
Northern States Power 7 per cent	a 96	91	97
Ohio Public Service 7 per cent	a 93	86	100
Pacific Gas & Electric 6 per cent	a 92	85	94
Penn-Ohio Power & Light 7 per cent	91	84	96½
Pennsylvania Power & Light $7—no par	98½	93	99½
Penn. Public Service 7 per cent	a 90	90	100
‡Philadelphia Electric 8 per cent—25	a 40	29½	40
Southern California Edison 8 per cent	a116	112	120
Tennessee Electric Power, 6 per cent	a 73½	47	73½
Texas Power & Light 7 per cent	98	95	98
Utah Power & Light 7 per cent	96	94	96½
Western States Gas & Electric 7 per cent	a 82	78	86
Yadkin River Power, 7 per cent	96½	94	99
Holding Companies			
American Gas & Electric 6 per cent—50	a 45½	41½	46
American Light & Traction	a 93½	91	94½
American Power & Light 6 per cent	a 87	84	91
American Public Service 7 per cent	a 88	84	95
American Public Utilities 7 per cent	a 88	73	88
American Water Works & Electric 7 per cent	a101	89½	101
Associated Gas & Electric 7 per cent—1 per cent extra—50	a 49	42	52
Carolina Power & Light 7 per cent	a100	95½	101
Central Indiana Power 7 per cent	a 88	80	93
Cities Service 6 per cent	a 80½	67	83
Commonwealth Power 6 per cent	a 82	72	82½
Consolidated Gas 6 per cent—50	a 57½	51	59½
Continental Gas & Electric 7 per cent pr. pf.	a 89½	69	93
Electric Bond & Share 6 per cent	a102	96½	104
General Gas & Electric—$8—no par	a105	96	105
*Middle West Utilities 7 per cent	a 94	80	94
National Power & Light—$7—no par	a 94	84	96½
North American 6 per cent—50	a 46½	43½	50½
Northern Ohio Electric	a 26	16	34
Public Service Corp. of N. J. 7 per cent	99	96½	101½
Public Service Corp. of N. J. 8 per cent	108	99½	115
Standard Gas & Electric 8 per cent—50	50	46½	50
‡United Gas Improvement—50	a 57½	55½	58
United Light & Power—$6.50—no par	83½	75½	84
COMMON STOCKS			
Operating Companies			
Adirondack Power & Light—50	a 37	22½	37
Appalachian Power—no par	a 77	66	93
Arkansas Light & Power	a 60	22	63
Brooklyn Edison	a121½	107½	124½
Buffalo General Electric	a190	118	190
Colorado Power	a 33	21	35
*Commonwealth Edison	a136	126	136½
§Consolidated Gas, Electric Light & Power	a 32½	32½	37½
Dayton Power & Light	a170	70	180
Detroit Edison	a113½	102½	115½
|| Edison Electric Illuminating of Boston	a201	163½	201
Long Island Lighting	200	100	200
Mississippi River Power	a 34	18	35
Montana Power	a 73½	61½	74½
Niagara Falls Power—no par	a 43	42	47
Niagara, Lockport & Ontario Power—no par	a 54	42	54
Northern Ohio Electric—no par	a 8	5	16
Northern States Power	a105	92	106
North Texas Electric	a 70	58	84
Pacific Gas & Electric	a105	90½	105
‡Penn Central Light & Power—no par	60½	57	60½
§Pennsylvania Water & Power	a129	98½	135½
‡Philadelphia Electric—25	a 40½	29	40½
*Public Service Co. of Northern Illinois	a111	99	111½
Puget Sound Power & Light	a 53½	43½	61½
Southern California Edison	a101½	95	106
Tampa Electric	a170	134	170
Tennessee Electric Power—no par	a 51	20	51
Virginia Power	a 70	16	70
Virginia Railway & Power	a 69½	36	72½
West Penn. Co.	a120	47½	121
Holding Companies			
‡American Electric Power—50	61	22½	62½
American Gas & Electric—no par	a 84	43½	115
American Light & Traction	a140	115	148
American Power & Light	a 68	34½	68
American Public Utilities	a 75	35	97
American Water Works & Electric	a 41½	24	41½
Carolina Power & Light—no par	a328	82½	330
Cities Service	a176	140	187
Columbia Gas & Electric—no par	a 48	33	48
Commonwealth Power Corp.—no par	a130	56	130
Consolidated Gas—no par	a 78	60½	79½
Continental Gas & Electric	a 84	49	96
Federal Light and Traction	115	75	122½
General Gas & Electric	a 73	22	75
Lehigh Power Securities—no par	a110	31	110
*Middle West Utilities—no par	a 88½	41	88½
National Power & Light—no par	a247	60	247
North American—10	a 43	22	45
Philadelphia Co.—50	a 57½	42½	57½
Power Securities—no par	a 18	4	18
Public Service Corp. of N. J.—no par	a 70	39	70
Standard Gas & Electric—no par	a 40½	31½	41½
United Gas & Electric (Conn.)—no par	a 31½	14	42
Utah Securities	a 46	16½	46
BONDS			
Operating Companies			
Adirondack Power & Light 6s 1950	a102½	97½	103
Alabama Power 5s 1946	a 95½	90½	97
Appalachian Power 5s 1941	a 95½	89	96
Brooklyn Edison 5s 1949	a 99½	97½	102½
Brooklyn Edison 6s 1930	a107	102½	107
Brooklyn Edison 7s 1940	107½	107	110½
Cleveland Electric Illuminating 5s 1939	a 99½	98½	101
Commonwealth Edison 5s 1943	a 99½	95	101
Commonwealth Edison 5s 1953	a 98½	92	99½
§Consol. Gas, Elec. Lt. & Pwr. 4½s 1935	92½	91	96
Consumers' Power 6s 1949	105	102½	106
Consumers' Power 5s 1936	a 98½	94½	99½
Detroit Edison 5s 1952	a 91	87	92½
Detroit Edison 5s 1933	a100½	99	101½
Duquesne Light 6s 1949	a105½	103½	106½
Great Western Power 5s 1946	95	90½	96
Kansas City Power & Light 5s 1952	a 96½	89	96½
Mississippi River Power 5s 1951	a 96½	92	97½
Montana Power 5s 1943	a 97½	95	99
New England Power 5s 1951	a100	97	101½
New York Edison 6½s 1941	a112½	109½	114½
Niagara Falls Power 6s 1950	a105½	104	106
Northern States Power 5s 1941	a 93	89½	94½
Northern States Power 6s 1941	a104½	101	105
Ohio Power 7s 1951	a106	103	107
Pacific Gas & Electric 5s 1942	a 94½	90½	95
Pennsylvania Water & Power 5s 1940	a 99½	96	100
‡Philadelphia Electric 5s 1966	a101	97	103½
Portland Electric Power 5½s 1947	104½	99½	104½
Portland Electric Power 6s 1941	a106½	103½	107½
Southern California Edison 6s 1947	94	89½	97
Southern California Edison 5s 1939	a 99	96	100
Tennessee Electric Power 6s 1944	a102½	100	103½
Texas Power & Light 6s 1947	a 99½	93½	99½
Texas Power & Light 5s 1937	96½	91½	97
Toledo Edison 7s 1941	a109½	106	110
Utah Power & Light 5s 1944	a 91½	87½	93½
Holding Companies			
Alabama Traction, Light & Power 5s 1962	a 85½	65½	86
American Gas & Electric 6s 2014	a 94½	94	95½
American Power & Light 6s 2016	a 93½	91	94½
Amer. Water Works & Electric 5s 1934	a 92½	84½	94
Associated Gas & Electric 6½s 1954	94	92½	94½
Central Indiana Power 6s 1947	a 95½	88	96½
Commonwealth Power 6s 1947	a 97½	87	98
Consolidated Cities Lt., Pwr. & Tr. 5s 1962	a 76	64	76½
Illinois Power & Light 6s 1953	a101	95	101
United Light & Railways 5s 1932	94	87½	94½
United Light & Railways 6s 1952	96	92	97½
ELECTRICAL MANUFACTURING COMPANIES			
PREFERRED STOCKS			
Allis-Chalmers Manufacturing	=103½	90	104½
*National Carbon	122	112	125
Worthington Pump & Machinery—A	85½	68	89½
COMMON STOCKS			
Allis-Chalmers Manufacturing	a 73	41½	73½
American Bosch Magneto—no par	a 34	22½	38½
Electric Storage Battery—no par	c 63½	50½	66
General Electric	a301	193½	301
General Electric—10	a 11½	10½	11½
*Hurley Machine—no par	a 62½	48	66
†Wagner Electric	28	20	34½
Westinghouse Electric & Manufacturing—50	a 71½	55½	71½
Worthington Pump & Machinery	a 80½	23½	80½
BONDS			
Canadian General Electric 6s 1942	a107½	102½	107
General Electric 3½s 1942	84	80	84½
General Electric 5s 1952	a105	100	105½
Robbins & Myers 7s 1952	66	65	91½
†Wagner Electric Manufacturing 7s	101	97	101
Western Electric 5s 1944	a 98½	96	99½
Westinghouse Electric & Mfg. 7s 1931	a107½	106½	109½

*Chicago Stock Exchange. †St. Louis Stock Exchange. ‡Philadelphia Stock Exchange. || Boston Stock Exchange. § Baltimore Stock Exchange
a Bid price Tuesday, December 30.

Electric Bond & Share Company, the common stock of which has always been owned by the General Electric Company.

"The Electric Bond & Share Company, organized in February, 1905, has grown in size and effectiveness. It was an important factor in improving central-station efficiency, in reducing cost of electric service to the public and interesting a larger number of investors in the advantages of securities in this field.

"The conditions in the electrical industry have changed; the public now recognizes investments in electrical public service enterprises as of demonstrated safety and stability.

"In view of these changed conditions the principle of separating the Electric Bond & Share Company from the General Electric Company has been under consideration for a long time, and today the board of directors took action determining the method of accomplishing it.

"The administration of the Electric Bond & Share Company will continue under the presidency of S. Z. Mitchell, to whose able, alert and resourceful leadership its conspicuous success and prosperity is in a great measure due."

The common stock of Electric Bond & Share, owned entirely by General Electric, had no public market. In the year ended October 31, 1923, Electric Bond & Share common earned $32.70 a share. Public utility bankers estimate the value of Electric Bond & Share investments all the way from $100,000,000 to $125,000,000, or from $55 to $70 a share for the stock of the new corporation.

The Electric Bond & Share Company has a surplus today of $18,000,000, compared with a surplus on December 31, 1923, of about $14,000,000. Total assets on December 31, 1923, were $62,552,380, an increase of $20,000,000 over those on December 31, 1922. Net working capital of $24,764,782 appears on the December 31, 1923, balance sheet, which was about double that of 1922. These figures indicate the growth of the company, as do current assets on December 31, 1923, of more than $26,000,000, which were about double those of 1922.

The decision of the General Electric Company to separate the public utility end of its business from the manufacturing end was distinctly a surprise to Wall Street, and General Electric stock, which had risen 100 points within the year, advanced sharply to a new high point of 307⅞. Some uncertainty developed as to the possible effect of the retirement of General Electric from the public utility field, and selling carried the quotation down to 296, closing at 297, a net loss for the day of 2⅞.

Company Reports

Among the company reports issued during the past week for the month of November are the following:

Name of Company	Gross Revenues for November 1924	1923
Alabama Power	$874,615	$783,050
Central Power & Light*	334,792	290,741
Commonwealth Power	2,737,441	2,771,267
East Penn Electric	270,327	277,063
Georgia Railway & Power	1,397,552	1,457,871
Great Western Power	690,567	654,224
Kansas City Power & Light	825,520	816,009
Manchester Traction, Light & Power and subs	217,035	208,990
Newport News & Hampton Railway, Gas & Electric	158,920	162,942
Philadelphia Company and affiliated corps	3,313,422	3,358,301
So. Canada Power and subs	92,623	86,393
Staten Island Edison	241,771	240,623
Tennessee Electric Power	887,754	802,277
Washington Water Power	469,250	476,757

*October

Tennessee Electric Earnings.—Earnings of the Tennessee Electric Power System for the twelve months ended November 30 amounted to $1,766,878 after deduction for fixed charges and first preferred dividends.

December Flotations $84,000,000

Total Amount of Electric Light and Power Offerings Made During the Last Month of Year Shows Decrease Under November Total

TWENTY-SEVEN electric light and power companies offered new issues of bonds, notes and stocks to the amount of $84,411,100 during the month of December as compared with $106,640,000 during the previous month and against $119,446,000 for the month of December, 1923, the banner month of that year. What was true of the utility financing during November applied also to December in respect to the purpose for which the issues were floated, and that is that the money was raised largely to defray expenses incurred for construction and for additions and betterments, though refunding was not entirely out of the picture. The largest individual offering was made by the Philadelphia Electric Company to the amount of $12,500,000 in first lien and refunding mortgage bonds, the price being 99½ to yield 5.03 per cent. The average yield for the month was 6.15 per cent.

SECURITY ISSUES OF ELECTRIC SERVICE COMPANIES IN DECEMBER

Name of Company	Amount of Issue	Period, Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Adirondack Power & Light Corp. (N.Y.)	$2,000,000	26	First and refunding mortgage gold bonds	Construction	5½	100	5.50
Columbus Electric & Power (Ga.)	2,000,000	30	First and refunding mortgage gold bonds, series B	Construction	5	92	5.55
	2,000,000	3	Gold notes	Construction	5	99¼	5.25
Interstate Power Co. (Wis.)	2,500,000	10	General mortgage gold bonds	Retirement of underlying bonds, acquisition of stock and other corporate purposes	7	99	7.15
Manchester Traction Light & Power Co. (N. H.)	1,000,000	28	First refunding mortgage sinking-fund gold bonds	Construction	5	95	5.35
Nevada-California Electric Corp.	1,300,000	26	First lien gold bonds, series B	Construction	6	98	6.15
North American Utility Security Corp.	10,000,000	...	First preferred stock	New capital	6	100	6
Northern New York Utilities, Inc.	750,000	...	Cumulative preferred stock	Construction and to reimburse for additions and extensions	7	102	6.85
Southern Cities Power Co. (Tenn.)	300,000	2	Notes	Acquisition of stock	6	98.15	7
United Light & Railways (Del.)	5,000,000	...	Cumulative prior preference stock	Acquisition of stock	6½	95	6.85
Electric Bond & Share Co. (N. Y.)	2,600,000	...	Cumulative preferred stock	General corporate purposes	6	102	5.88
Edison Electric Co. (Pa.)	575,000	19	First and refunding mortgage gold bonds	Refunding and to reimburse for additions	5	99	5.05
Illinois Power & Light Corp.	5,000,000	30	First and refunding mortgage gold bonds, series B	Refunding and to reimburse for additions	5½	97	5.70
Union Electric Light & Power Co. (Mo.)	5,000,000	30	General mortgage gold bonds, series A	Additions and extensions	5	99	5.07
Louisiana Power Co.	2,250,000	20	First mortgage sinking-fund gold bonds	Construction	6	94	6.55
Central Illinois Light Co.	851,100	19	First and refunding mortgage bonds		5	95½	5.38
Georgia Light, Power & Railways	2,500,000	3	Gold notes	Refunding and for corporate purposes	6	99½	6.20
Georgia Railways & Electric Co.	3,151,000	25	Refunding and improvement mortgage sinking-fund gold bonds	Additions	5	90½	5.75
Western Power Corp.	6,000,000	30	Sinking-fund secured gold debentures, series A	Acquisition of properties	6½	98.50	6.60
Federal Light & Traction Co.	2,500,000	30	Debenture gold bonds, series B	Refunding and for extensions	6	91	6.70
Utilities Power & Light Corp.	3,750,000	...	Class A stock	Additional investment in subsidiary companies and other corporate purposes	2	25	8
Philadelphia Electric Co.	12,500,000	35	First lien and refunding mortgage gold bonds	Construction	5	99½	5.03
Indiana General Service Co.	884,000	24	First mortgage gold bonds	New capital	5	94½	5.40
Associated Gas & Electric Co.	1,000,000	...	Preferred stock	To reimburse for new properties	4	50	8
Canada Northern Power Corp., Ltd.	3,500,000	...	Cumulative preferred stock	New capital	7	99	7.07
Memphis Power & Light Co.	1,000,000	24	First and refunding mortgage gold bonds, series A	To reimburse for expenditures for additions and other corporate purposes	5	96	5.30
					6	99½	6.04
Tennessee Electric Power Co.	3,000,000	23	First and refunding mortgage gold bonds	Expansion	6½	100	6.50
Broad River Power Co.	1,500,000	10	Secured sinking-fund gold bonds				
Total	$84,411,100						

New Financial Set-up

Northern Ohio Electric Corporation Controlling Akron Utility to Take New Form

A PLAN of reorganization of the Northern Ohio Electric Corporation is being submitted to the stockholders providing for the formation of a new company to be called the Northern Ohio Power Company (or some other suitable name), which will issue bonds and stock and raise the necessary funds to pay the $2,680,000 loan maturing February 1, 1925. The new company will take over the assets of the present company, consisting chiefly of virtually the entire outstanding $10,000,000 common stock of the Northern Ohio Traction & Light Company, which does a general electric light and power business in Akron and operates city and interurban railways.

The new company is to have the following capitalization: $2,800,000 (which may be increased to $3,500,000 upon exercise of options) ten-year 7 per cent bonds, due February 1, 1935; to be secured by pledge of practically the entire outstanding $10,000,000 common stock of the Northern Ohio Traction & Light Company; 430,000 shares of an authorized issue of 500,000 shares of capital stock without par or face value; 70,000 options expiring August 1, 1926, each ten options calling for delivery of $100 bond and ten shares of capital stock upon payment of $100.

The plan provides for the deposit of the outstanding 60,000 shares of preferred and 75,000 shares of common stock of the Northern Ohio Electric Corporation with either the Bankers' Trust Company, New York, or the Bank of North America & Trust Company, Philadelphia, for exchange for capital stock of the new company on the following basis: For each share of preferred stock of the Northern Ohio Electric Corporation there will be delivered two shares of the capital stock of the new company; for each share of common stock of the Northern Ohio Electric Corporation there will be delivered four-tenths of a share of the capital stock of the new company.

The depositing stockholders are offered for subscription $2,800,000 ten-year 7 per cent bonds, 280,000 shares capital stock and 70,000 options, in amounts of $100 or multiples thereof, on the following terms: $100 bonds, ten shares capital stock, two and one-half options, for the sum of $100. Preferred-stock depositors are entitled to prior right to subscribe pro rata with secondary right to common stock depositors subject to allotment.

A 10 per cent payment must accompany all subscriptions, 15 per cent to be paid when plan is declared operative; 25 per cent each in two, four and six months thereafter; interest at 6 per cent to be adjusted at the time of final payment. The entire subscription has been underwritten for a commission of 5 per cent, thus assuring the receipt of funds necessary to pay the $2,680,000 loan due February 1, 1925. Upon exercise of the 70,000 options, the new company will be provided with $700,000 additional capital. The plan is not required to be declared operative unless 90 per cent of the preferred and common stock is deposited, but may be declared operative on the deposit of less. The exchange offers, unless extended, expire January 15, 1925, and the subscription offers expire January 26, 1925, and cannot be extended. A series of eighteen questions and answers explaining the plan in detail has been mailed to stockholders.

Electric Light & Power Maturities in 1925

Below are given in detail the bonds and notes of electric light and power companies maturing in 1925, as compiled by Dow, Jones & Company:

Due		Corporation	Rate	Amount
JANUARY				
Jan.	1	Middle West Utilities clt..	6	$9,301,500
Jan.	1	Potomac El. Pr. gen. deb...	6	750,000
Jan.	1	Danville St. Ry. & Lt. ref..	5	622,000
Jan.	1	Consol. El. Lt. (Maine) 1st	4½	500,000
Jan.	1	General Gas & E. 10-yr....	5	402,500
Jan.	15	Edison Electric Illuminating of Boston, 3-yr.....	5½	12,000,000
Jan.	15	Ed. El. Illum. of Boston, 7½ mos.....	5	8,000,000
Jan.	15	Southern Calif. Edison ser.	7	1,000,000
FEBRUARY				
Feb.	1	Ga. Lt., Pwr. & Rys. nts...	7	$1,000,000
MARCH				
Mch.	1	Utica Gas & E. gen. A.....	7½	$2,000,000
Mch.	1	Wisc. Gas & El. conv. B...	7	500,000
Mch.	1	San Joaquin Lt. & Pr. ref..	7	400,000
Mch.	1	Citizens Gas & El. 2nd....	5	300,000
Mch.	1	Kings Co. El. Lt. & Pr. conv.	6	295,100
APRIL				
Apr.	1	Buffalo Gen. Elec. cv.....	7	$729,500
Apr.	1	Amer. Pub. Serv. notes A.	7½	500,000
Apr.	1	Lima El. Ry. & Lt. 1st....	5	350,000
MAY				
May	1	Western Lt. & Pwr. 1st....	5	$2,270,000
May	1	Eastern Texas Elec. cv....	7	1,346,300
May	1	Passaic Lighting cons.....	5	316,000
May	1	Empire G. & El. joint conv.	7	285,000
May	1	United Pwr. & Lt. deb....	6	250,000
May	1	Binghamton Light, Heat & Power sec.....	7	227,500
JUNE				
June	1	Cen. States Elec. 2-yr. nts.	7	$1,621,000
June	1	Ohio River El. Ry. & Pwr. 1st.....	6	315,000
June	15	West Penn. Co. 3-yr. deb..	6	2,439,500
JULY				
July	1	Central Indiana Pwr. cv...	7	$2,000,000
July	1	El Paso Elec. Notes A.....	7	1,550,000
July	1	Savannah El. & Pwr. 2-yr.	6½	1,000,000
July	1	El Paso Electric notes B..	5	800,000
July	1	Com'wealth Lt. & Pr. 2-yr.	7	600,000
July	1	Ed. El. Il. Paterson 1st...	5	585,000
July	1	Wisc. Gas & E. conv. C..	7	408,000
July	1	Keokuk Elec. 2½-year.....	6	400,000
July	1	Cons. P. & Lt., S. D., 1-yr.	6	350,000
July	1	Citizens Lt., Ht. & Pr. 1st	5	300,000
July	1	Amer. Pub. Ser. notes B..	7½	233,100
AUGUST				
Aug.	1	Toledo Trac., L. & P. 3-yr	6	$6,271,500
Aug.	1	Gal.-Houston Elec. nts. A.	7	1,700,000
Aug.	1	Houston Electric 1st.....	5	1,319,000
Aug.	1	Toledo Tr., Lt & Pr. 2-yr.	6½	1,100,000
Aug.	1	Kennebec L. & H. cons...	4½	228,000
Aug.	31	Ohio Pub. Ser. 1-yr.....	5	1,000,000
SEPTEMBER				
Sept.	1	Puget Sound Pr. & L. 5-yr	8	$2,000,000
Sept.	1	Helena Lt. & Ry. 1st.....	5	969,000
Sept.	1	Prange Cty. P. Ser. 2-yr..	6½	550,000
OCTOBER				
Oct.	1	Cen. Hudson Gas & E. cv.	6	$246,200
NOVEMBER				
Nov.	1	Gt. West. Pr., Cal., deb..	6	$4,177,600
Nov.	1	New England Co. conv...	6	2,508,000
Nov.	1	Salem El. Lighting 1st....	8	500,000
Nov.	1	Fitchburg Gas & El., 3-yr.	5	450,000
Nov.	15	Western Pub. Service 1-yr.	6½	500,000
DECEMBER				
Dec.	1	Louisville & No. Ry. & Lt.	5	500,000
		Total for year.....		$79,971,300

Dividends Declared

The following quarterly dividends were announced by central-station companies and electrical manufacturing companies during the past week:

Name of Company	Per Cent	When Payable
American Electric power, pf.....	$1.75	Feb. 16
Arizona Power, 7% pf.....	1¾	Jan. 2
Arizona Power, 8% pf.....	2	Jan. 2
Buffalo General Electric.....	2	Dec. 31
Central Power, pf.....	1¾	Jan. 15
Chickasha Gas & Electric, pf.....	1½	Dec. 31
Eastern Kansas Power, pf.....	1¾	Jan. 1
Eastern Texas Electric, com.....	$1.25	Jan. 2
Eastern Texas Electric, pf.....	3½	Jan. 2
Edison Elec. Illum. of Brockton, ex.	50c.	Dec. 31
Electric Light & Power of Abington & Rockland.....	50c.	Jan. 2
Elmira Water, Light & R.R., 1st pf.	1¾	Dec. 31
Elmira Water, Light & R.R. 2d pf.	1¾	Dec. 31
Harrisburg Light & Power, pf.....	1	Dec. 31
International Utilities, pf., A.....	87½c.	Jan. 15
Kansas Electric Power, pf.....	1¾	Jan. 1
Kings County Lighting, 7% pf.....	$41.75	Jan. 2
Long Island Lighting, pf.....	1¾	Jan. 2
Lowell Electric Light, extra.....	75c.	Dec. 31
Manchester Traction, Light & Power	2	Jan. 15
Memphis Power & Light, pf.....	$1.75	Jan. 1
Michigan Gas & Electric, pr. lien....	1¾	Jan. 15
Michigan Gas & Electric, pf.....	1¾	Jan. 21
Mountain States Power, pf.....	1¾	Jan. 2
New Jersey Power & Light, pf.....	1¾	Jan. 2
Public Service of Oklahoma, pr. lien.	1¾	Dec. 31
Public Service of Oklahoma, pf.....	1¾	Dec. 31
Public Service Electric Power, pf....	1¾	Feb. 2
United Gas & Electric, pf.....	2¼	Jan. 15
Western Power, pf.....	1¾	Jan. 15
Philadelphia Insulated Wire*.....	$2	Feb. 1
Superheater Company.....	$1.50	Jan. 15
Superheater Company, extra.....	$4	Jan. 3
Wagner Electric, pf.....	1¾	Jan. 1

* Semi-annual.

Utility Plans New Financing.—The directors of the Hartford (Conn.) Electric Light Company have recommended an issue of $4,000,000 in 7 per cent three-year notes to retire $3,000,000 of 7 per cent gold notes and to meet capital requirements. Action will be taken on the proposal January 6.

Washington Railway & Electric Receives Authorization for Bond Issue.—The Washington Railway & Electric Company has been authorized by the Public Utilities Commission of the District of Columbia to issue and sell general and refunding mortgage 6 per cent ten-year gold bonds to the amount of $1,850,000. The funds thus obtained will be used to retire a similar amount of Metropolitan Railroad Company bonds falling due February 1, 1925. Authority was granted subject to certain technical conditions to be fulfilled by the company to the satisfaction of the commission.

Wisconsin Company Receives Authorization.—The Wisconsin Electric Power Company, which is operated under lease by the Milwaukee Electric Railway & Light Company, has been granted authority by the Railroad Commission of Wisconsin to place on sale a new issue of $1,000,000 in preferred shares, the proceeds of which will be used to finance the growth of the company's Lakeside generating station during the coming year.

Pittsburgh Utility Stock Listed.—The New York Stock Exchange has admitted to listing $1,650,000 7 per cent cumulative preferred stock of the Pittsburgh Utilities Corporation, making the total authorized for listing $4,770,700. In its statement for eleven months ended November 30 the corporation shows net income of $1,253,053 after expenses, taxes and interest.

Eng

Number of Line 1	Name of Company and Terminals of Transmission Lines 2	Year During which Line Was Constructed 3	Capacity of Connected Plants, Kva.		Rating of Line—Kva.			Current		
			Pres. 4	Ult. 5	Normal 6	Maximum 7	Ultimate 8	Voltage 9	Phase 10	Cycles 11
	New England States									
1	*Hortonia Power Co.*									
	Brandon-Crown Point	1917	6,525	.....	2,500	3,500	.....	44,000	3	25
	Vermont Hydro-Elec. Corp.									
2	Claremont—Charlestown	1917	315	315	3,500	7,000	7,000	44,000	3	60
3	Claremont—Cavendish	1913	1,500	1,500	3,000	4,600	.....	44,000	3	60
4	Claremont—Windsor	1915	.....	.....	600	4,500	2,000	44,000	3	60
5	Charlestown-Springfield	1914	.....	.....	0	3,500	.....	44,000	3	60
6	Springfield—Cavendish	1913	.....	.....	1,500	2,500	.....	44,000	3	60
7	Cavendish—Mendon	1913	2,000	2,000	4,000	2,000	.....	44,000	3	60
8	Mendon—Pittsford	1913	3,250	3,250	1,600	3,250	.....	44,000	3	60
9	Mendon—Hydeville	1915	335	335	3,500	4,000	.....	44,000	3	60
10	Hydeville—Carvers Falls	1915	2,000	4,000	2,000	10,000	4,000	44,000	3	60
11	Hydeville—No. Poultney	1915	.....	.....	1,500	10,000	.....	44,000	3	60
12	No. Poultney—Granville	1915	.....	.....	700	4,000	.....	44,000	3	60
13	Glen—Rutland	1915	2,500	2,500	800	2,500	.....	13,000	3	60
14	Mendon—Rutland	1915	.....	.....	800	1,500	.....	13,000	3	60
	Fall River Elec. Lt. Co.									
15	Fall River—Providence	1918	15,812	200,000	30,000	40,000	.....	66,000	3	60
	Twin State Gas & Elec. Co.									
16	Bennington—No. Adams	....	2,250	.....	.....	.....	.....	66,000	3	60
	Turners Falls Power & Elec. Co.									
17	Turners Falls—Amherst	1912	*a*	*b*	25,000	.....	75,00	*c*66,000	3	60
18	Turners Falls—Amherst	1913	*a*	*b*	25,000	.....	75,000	*c*66,000	3	60
19	Amherst—W. Springfield	1913	*a*	*b*	25,000	.....	75,000	*c*66,000	3	60
20	Amherst—Mt. Tom	1915	*a*	*b*	25,000	.....	75,000	*c*66,000	3	60
21	Amherst—Mt. Tom	1908	*a*	*b*	5,000	.....	5,000	*c*66,000	3	60
22	Mt. Tom—W. Springfield	1917	*a*	*b*	25,000	.....	75,000	*c*66,000	3	60
23	W. Springfield—Springfield	1913	*a*	*b*	50,000	.....	100,000	*c*66,000	3	60
24	Turners Falls—Pittsfield	1923	*a*	*b*	30,000	.....	90,000	*c*66,000	3	60
25	Agawam—Hartford	1925	*a*	*b*	30,000	.....	90,000	*c*66,000	3	60
	New England Power Co.									
26	Vernon—Bellows Falls	*FF* 1914-24	32,000	47,000	5,600	7,000	12,000	66,000	3	60
27	Vernon—Keene	1911	32,000	32,000	2,000	3,000	3,000	66,000	3	60
28	Vernon—Leominster	1908	32,000	32,000	25,000	40,000	40,000	66,000	3	60
29	Gardner—Barre	1912	.....	.....	1,000	1,500	1,500	66,000	3	60
30	Leominster—Washua	1917-18	.....	.....	10,000	15,000	15,000	66,000	3	60
31	Leominster—Millbury	*GG* 1908-12	.....	.....	15,000	25,000	25,000	66,000	3	60
32	Boston—Clinton	1919	.....	.....	10,000	18,000	18,000	66,000	3	60
33	Davis Bridge—Millbury	1924	32,000	48,000	32,000	40,000	70,000	110,000	3	60
34	Searsbury—No. 5 Station	1922	20,000	25,000	5,000	15,000	15,000	66,000	3	60
35	Adams—Bennington	1915	.....	.....	2,500	3,500	3,500	66,000	3	60
36	Adams—Albany	1923	.....	.....	15,000	30,000	30,000	110,000	3	60
37	No. 5 Station—Adams	1913	15,000	15,000	7,000	12,000	12,000	66,000	3	60
38	No. 5 Station—Shelburne Falls	1912	21,000	21,000	8,000	20,000	20,000	66,000	3	60
39	Shelburne Falls—Millbury	1913	18,000	21,000	25,000	40,000	40,000	66,000	3	60
40	Ware—Stafford Springs	1915	.....	.....	5,000	8,000	10,000	66,000	3	60
41	Norwich—Millbury	1919	.....	.....	10,000	10,000	20,000	66,000	3	60
42	Millbury—Pawtucket	1914	.....	.....	25,000	40,000	40,000	66,000	3	60
43	Lincoln—Seekonk	1923	.....	.....	25,000	40,000	40,000	66,000	3	60
44	Providence—Seekonk	1918	.....	.....	35,000	45,000	50,000	66,000	3	60
45	Seekonk—Fall River	1918	.....	.....	18,000	22,000	22,000	66,000	3	60
46	Shelburne Falls—Vernon	1912	36,000	36,000	10,000	15,000	15,000	66,000	3	60
	Connecticut Power Company									
47	Falls Village	1914	10,000	13,000	.....	.....	.....	66,000	3	60
48	Torrington	1914	2,300	?	.....	.....	.....	66,000	3	60
49	Thomaston	1914	.....	.....	.....	.....	.....	66,000	3	60
50	Bristol	.....	1,500	?	.....	.....	.....	66,000	3	60
51	Bristol 474—Berlin Pt. 12	1920	.....	.....	.....	.....	.....	66,000	3	60
52	Bristol 474—Berlin Pt. 12	1920	.....	.....	.....	.....	.....	66,000	3	60
53	Tap to New Britain	1916	?	?	.....	.....	.....	66,000	3	60
54	Berlin Pt. 12—Cromwell	1918	.....	.....	.....	.....	.....	66,000	3	60
55	Berlin Pt. 12—Cromwell	1924	.....	.....	.....	.....	.....	66,000	3	60
56	Berlin Pt. 12—Hartford	1915	?	?	.....	.....	.....	66,000	3	60
57	Berlin Pt. 12—Hartford	1924	?	?	.....	.....	.....	66,000	3	60
	Connecticut Light & Power Co.									
58	Devon—Bunker Hill	1923	50,000	200,000	25,000	.....	.....	66,000	3	60
59	Devon—Bunker Hill	1923	50,000	200,000	25,000	.....	.....	66,000	3	60
60	Stevenson—Bunker Hill	1918	23,400	31,200	20,000	.....	.....	66,000	3	60
61	Bunker Hill—Waterbury	1923	28,400	28,400	20,000	.....	.....	66,000	3	60
62	Bunker Hill—Waterbury	1923	28,400	28,400	20,000	.....	.....	66,000	3	60
63	Bunker Hill—Southington	1923	.....	.....	20,000	.....	.....	66,000	3	60
64	Bunker Hill—Southington	1923	.....	.....	20,000	.....	.....	66,000	3	60
65	Southington—New Britain	1923	.....	.....	20,000	.....	.....	66,000	3	60
66	Southington—New Britain	1923	.....	.....	20,000	.....	.....	66,000	3	60
67	Southington—Meriden	1924	.....	.....	20,000	.....	.....	66,000	3	60
68	Southington—Meriden	1924	.....	.....	20,000	.....	.....	66,000	3	60
69	Devon—Norwalk	1923	50,000	200,000	20,000	.....	.....	66,000	3	60
70	Devon—Norwalk	1924	50,000	200,000	20,000	.....	.....	66,000	3	60
71	Derby—Tie Line	1923	.....	.....	20,000	.....	.....	66,000	3	60
72	Derby—Tie Line	1923	.....	.....	20,000	.....	.....	66,000	3	60

Middle Atlantic States—(See end of tabulation for additional lines in this section)

ngineering Details of the T

nt		Line Connections							Conductors		
				Grounding							
ase 10	Cycles 11	Step-up 12	Step-down 13	Solid Neutral 14	Resistance, Amount 15	Locations 16	Circuits per Tower 17	Length in Single Circuit Miles 18	Section—Gage or CirMil. 19	Material 20	Spac
3	25	3,300 to 44,000	44,000 to 3,300	No grounding	g		1	27.4	No. 4, B & S.	St.	
3	60		44,000 to 2,300				1	12	No. 2.	Cu.	
3	60	11,200 to 44,000					1	19	No. 2.	Cu.	
3	60		44,000 to 440				1	6	No. 4.	Cu.	
3	60						1	6	No. 6.	Cu.	
3	60		44,000 to 2,300				1	12	No. 6.	Cu.	
3	60	13,200 to 44,000					1	30	No. 4.	Cu.	
3	60	23,000 to 44,000					1	3	No. 4.	Cu.	
3	60		44,000 to 2,300 and 4,600				1 and 2	21	1 and 4	Cu.	
3	60	2,300 to 44,000					1 and 3	5	No. 2.	Cu.	
3	60		44,000 to 13,200				1	5	No. 1.	Cu.	
3	60		13,200—2,300				1	12	No. 4.	Cu.	
3	60						1 and 2	2	No. 4.	Cu.	
3	60		13,200 to 2,300				1	4	No. 4.	Cu.	
3	60		2—15,000 kva. banks.	Yes		Gen. stat.	2	22.9	No. 0.	Cu.	
3	60	Delta.	Delta.				1	24	0	Al.	
3	60	c.	c.	d.	d.		2	17.52	1/0	7—Str.	
3	60	c.	c.	d.	d.		2	17.52	2/0	S. H. D. Cu.	
3	60	c.	c.	d.	d.		2	20.62	1/0	S. H. D. Cu.	
3	60	c.	c.	d.	d.		2	11.3	1/0	S. H. D. Cu.	
3	60	c.	c.	d.	d.		1	8.44	No. 2.	S. H. D. Cu.	
3	60	c.	c.	d.	d.		2	21	1/0	S. H. D. Cu.	
3	60	c.	c.	d.	d.		2	2.7	1/0	S. H. D. Cu.	
3	60	c.	c.	d.	d.		2	36.7	2/0	S. H. D. Cu.	
3	60	c.	c.	d.	d.		2	32	4/0	Alum. Steel Reinf.	
3	60	2,300	6,600	Yes		Vernon	1	31.4	No. 2.	Cu.	
3	60	2,300	2,300	Yes		Vernon	1	19.0	1/0	Cu.	
3	60	2,300	13,000	Yes		Vernon Gardner Leominster	2	45.4	2/0	Cu.	
3	60	None.	440	Yes		Gardner	1	16.7	4	Cu.	
3	60	None.	13,000	Yes		Leom. Ayer	2/	27.7	2	Cu.	
3	60	None.	13,000	Yes		Leominster Worcester	2	17.9	No. 2.	Cu.	
3	60	22,000	None.	Yes		Clinton	1	38.0	1/0	Cu.	
3	60	6,600	66,000	Yes		Millbury Davis B.	1 pres.—2 ult.	74.3	4/0	Cu.	
3	60	2,300	None.	Yes		Searsbury No. 5	1	14.3	2/0	Cu.	
3	60	None.	33,000	Yes		Adams	1	17.9	2 equiv.	Al.	
3	60	66,000	66,000	Yes		Adams	1	40.2	4/0	Cu.	
3	60	2,300	22,000	Yes		Adams No. 5	2	8.2	No. 1	Cu.	
3	60	2,300	None.	Yes		No. 5 Shel. Falls	2	14.7	No. 1.	Cu.	
3	60	2,300	None.	Yes		Shel. Falls Millbury	2	63.8	2/0	Cu.	
3	60	None.	22,000				1	25.4	No. 1—No. 2.	Cu.	
3	60	11,000	None.	Yes		Millbury	1	58.7	2/0	Cu.	
3	60	None.	22,000	Yes		Millbury Pawtucket	2	28.9	2/0	Cu.	
3	60	None.	None.				2	14.4	2/0	Cu.	
3	60	11,000	None.	Yes		Providence	2	5.0	1/0	Cu.	
3	60	None.	22,000				2	11.5	1/0	Cu.	
3	60	None.	None.	Yes		Shel. Falls Ver non	2	16.6	No. 1.	Cu.	
3	60	Yes.	Yes.				2		No. 2.	Cu.	
3	60		Yes.				2	22.0	No. 2.	Cu.	
3	60		Yes.				2	9.4	No. 2.	Cu.	
3	60		Yes.				2	7.05	No. 2.	Cu.	
3	60						2	14.17	No. 2.	Cu.	
3	60						2		No. 0.	Cu.	
3	60	Yes.	Yes.				1	1.5	No. 2.	Cu.	
3	60		Yes.				1	5.4	No. 2.	Cu.	
3	60		Yes.				1 on 2 C.T.	5.4	No. 00.	Al.	
3	60	Yes.	Yes.	Yes.		Trans.	1	10.33	No. 0.	Cu.	
3	60	Yes.	Yes.	Yes.		Trans.	1 on 2 C.T.	10.33	No. 0000.	Al.	
3	60	Delta Star.		Yes.	0	Devon.	2	27.10	4/0	Cu.	
3	60	Delta Star.		Yes.	0	Devon.		27.10	4/0	Cu.	
3	60	Delta Star.		Yes.	0	Stev.	1	13.38	2/0	Cu.	
3	60		Delta Delta.	No.			2	2.10	2/0	Cu.	
3	60		Delta Delta.	No.				2.10	2/0	Cu.	
3	60		Delta Delta.	No.			2	13.95	2/0	Cu.	
3	60		Delta Delta.	No.				13.95	2/0	Cu.	
3	60		Delta Delta.	No.			2	6.33	2/0	Cu.	
3	60		Delta Delta.	No.				6.33	2/0	Cu.	
3	60		Delta Delta.	No.			2	5.36	4/0	Cu.	
3	60		Delta Delta.	No.				5.36	4/0	Cu.	
3	60	Delta Star.	Delta Delta.	Yes.	0	Devon.	2	23.34	2/0	A.C.S.R.	
3	60	Delta Star.	Delta Delta.	Yes.	0	Devon.		23.34	2/0	Cu.	
3	60		Delta Delta.	No.			2	1.48	2/0	Cu.	
3	60		Delta Delta.	No.				1.48	2/0	Cu.	
										Al. 19 Strands.	

Supplement of ELECTRICAL WORLD, January

he Transmission Lines in t

A Survey Covering 777 High-Tension
Showing Past and Present Engineering Practice and t

Compiled by ELECTRICA

Conductors			Clearance, Ft.				Span				Insulators per Straight Run		Conductor	
rMil.	Material 20	Spacing Inches 21	To Ground 22	To Highway 23	To Tracks 24	From Line to Telephone 25	Normal Feet 26	Maximum Feet 27	Normal Sag—Feet 28	Normal Tension Pounds 29	No. of Units and Type 30	Manufacturer 31	No. of Units and Type 32	Strai
.....	St.....	52	20	30	30	6	130	1,088	1	.....	Pin type.....	Lock.....	.....	.....
.....	Cu.....	35½ and 68	20 and 25	30	35 and 40	5	135	150	1½	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	30 and 48	20 ann 25	30	35 and 40	5	250	275	4	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	35½ and 68	20 and 25	30	35 and 40	5	135	150	1½	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	48	20 and 25	30	35 and 40	5	135	150	1½	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	48	20 and 25	30	35 and 40	5	135	150	1½	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	48	20 and 25	30	35 and 40	5	135	150	1½	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	48	20 and 25	30	35 and 40	4	140	150	1½	.....	1 pin.....	Locke.....	.....	.....
and 4	Cu.....	24 and 30	20 and 25	30	35 and 40	4	140	150	1½	.....	1 pin.....	Locke.....	.....	.....
.....	Cu.....	24	20 and 25	30	35 and 40	4	140	275	4	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	48	20 and 25	30	35 and 40	4	.....	.....	.....	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	24 and 36	20 and 25	30	35 and 40	4	140	150	1½	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	24	20 and 25	30	35 and 40	4	140	150	1½	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	24	20 and 25	30	35 and 40	4	140	150	1½	.....	1 pin.....	Thomas.....	.....	.....
.....	Cu.....	96	25 to 35	50	50	No. tel...	600	1,214	16 to 18	.....	5—No. 1124...	Thomas.....	6—No. 1124.....	Thor
0	Al.....	60	25	28	.....	.....	200	800	2	.....	3	Ohio Brass.....	4	Ohio
1/0	7—Str.....	123	18 min.....	45	30 min....	12	600	696	21.1	695	4 Hewlett.....	Thomas or G.E.....	5 Hewlett.....	Thor
2/0	S. H. D. Cu.....	123	18 min.....	45	30 min....	12	600	696	17.8	1,035	4 Hewlett.....	Thomas or G.E.....	5 Hewlett.....	Thor
1/0	S. H. D. Cu.....	120	18 min.....	45	30 min....	12	600	e1,500	21.1	695	4 Hewlett.....	Thomas or G.E.....	5 Hewlett.....	Thor
1/0	S. H. D. Cu.....	99	18 min.....	45	30 min....	12	600	e1,052	21.1	695	4 Hewlett.....	Thomas or G.E.....	5 Hewlett.....	Thor
.....	S. H. D. Cu.....	66	18 min.....	45	30 min....	12	550	e1,177	26	354	1 pin.....	Thomas.....	3 pin.....	Thor
1/0	S. H. D. Cu.....	99	18 min.....	45	30 min....	12	600	e1,377	21.1	695	4 Hewlett.....	Thomas or G.E.....	5 Hewlett.....	Thor
1/0	S. H. D. Cu.....	99	18 min.....	45	30 min....	12	600	e1,664	21.1	695	4 Hewlett.....	Thomas or G.E.....	5 Hewlett.....	Thor
2/0	S. H. D. Cu.....	123	18 min.....	45	30 min....	12	600	944	17.8	1,035	6 Hewlett.....	Thomas or G.E.....	7 Hewlett.....	Thor
4/0	Alum. Steel Reinf....	123	18 min.....	45	30 min....	12	600	.....	5	2,850	6 Hewlett.....	Thomas or G.E.....	7 Hewlett.....	Thor
.....	Cu.....	72	.....	.....	.....	.....	150	.....	.....	.....	4	.....	5	.....
1/0	Cu.....	84	.....	.....	.....	.....	400	.....	.....	.....	Pin.....	.....	5	.....
2/0	Cu.....	72	.....	.....	.....	.....	375	.....	.....	.....	Pin.....	.....	6	.....
4	Cu.....	72	.....	.....	.....	.....	150	.....	.....	.....	Pin.....	.....	5	.....
2	Cu.....	72	.....	.....	.....	.....	200	.....	.....	.....	4	.....	5	.....
.....	Cu.....	72	.....	.....	.....	.....	475	.....	.....	.....	Pin.....	.....	6	.....
1/0	Cu.....	72	.....	.....	.....	.....	240	.....	.....	.....	4 pin.....	.....	5	.....
4/0	Cu.....	150	.....	.....	.....	.....	700	.....	.....	.....	8	.....	9	.....
2/0	Cu.....	102	.....	.....	.....	.....	350	.....	.....	.....	5	.....	6	.....
.....	Al.....	72	.....	.....	.....	.....	180	.....	.....	.....	3	.....	4	.....
4/0	Cu.....	150	.....	.....	.....	.....	400	.....	.....	.....	8	.....	9	.....
.....	Cu.....	120	.....	.....	.....	.....	500	.....	.....	.....	5	.....	5	.....
.....	Cu.....	120	.....	.....	.....	.....	600	.....	.....	.....	4	.....	6	.....
2/0	Cu.....	120	.....	.....	.....	.....	550	.....	.....	.....	6	.....	7	.....
.....	Cu.....	72	.....	.....	.....	.....	265	.....	.....	.....	4	.....	5	.....
2/0	Cu.....	72	.....	.....	.....	.....	250	.....	.....	.....	4	.....	5	.....
2/0	Cu.....	120	.....	.....	.....	.....	585	.....	.....	.....	6	.....	7	.....
2/0	Cu.....	120	.....	.....	.....	.....	160	.....	.....	.....	5	.....	6	.....
1/0	Cu.....	96	.....	.....	.....	.....	360	.....	.....	.....	5	.....	6	.....
1/0	Cu.....	96	.....	.....	.....	.....	550	.....	.....	.....	5	.....	6	.....
.....	Cu.....	72	.....	.....	.....	.....	400	.....	.....	.....	Pin.....	.....	.....	.....
.....	Cu.....	96	37	.....	.....	.....	450	1,100	14	.....	5	Locke and Pitts.....	6	Lock
.....	Cu.....	96	37	.....	.....	.....	450	1,100	14	.....	5	Locke and Pitts.....	6	Lock
.....	Cu.....	96	37	.....	.....	.....	450	1,100	14	.....	5	Locke and Pitts.....	6	Lock
.....	Cu.....	96	37	.....	.....	.....	450	1,100	14	.....	5	Locke and Pitts.....	6	Lock
.....	Cu.....	96	44	.....	.....	.....	450	1,100	14	.....	5	Locke.....	6	Lock
.....	Cu.....	96	44	.....	.....	.....	450	1,100	14	.....	5	Hewlett.....	6	Hew
.....	Cu.....	96	44	.....	.....	.....	450	1,100	14	.....	4	Thomas.....	5	Thor
.....	Cu.....	75	22	.....	.....	5	200	.....	1.5	.....	4	Locke.....	5	Lock
.....	Al.....	.....	49	.....	.....	.....	600	.....	.....	.....	5	Jeffery—Dewitt.....	6	Jeffr
.....	Cu.....	75	22	.....	.....	5	200	.....	1.5	.....	4	Locke.....	5	Lock
.....	Al.....	.....	45	.....	.....	.....	700	1,100	.....	.....	5	Jeffrey—Dewitt.....	6	Jeffr
4/0	Cu.....	96	24	24	32	8	700	1,580	20	2,000	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
4/0	Cu.....	96	24	24	32	8	700	1,580	20	2,000	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	Cu.....	96	24	24	32	8	500	760	12	1,040	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	Cu.....	96	24	24	32	8	400	650	8	1,040	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	Cu.....	96	24	24	32	8	400	650	8	1,040	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	Cu.....	96	24	24	32	8	650	1,000	21	1,040	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	Cu.....	96	24	24	32	8	650	1,000	21	1,040	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	Cu.....	96	24	24	32	8	650	1,615	21	1,040	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	Cu.....	96	24	24	32	8	650	1,615	21	1,040	5 disk.....	Jeffrey-Dewitt.....	Double strings of 7	Jeffr
4/0	Cu.....	96	24	24	32	8	700	1,070	20	2,000	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
4/0	Cu.....	96	24	24	32	8	700	1,070	20	2,000	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	A.C.S.R.....	84	24	24	32	8	450	1,080	9	500	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	Cu.....	84	24	24	32	8	450	1,080	9	500	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	Cu.....	96	24	24	32	8	650	1,658	21	1,040	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
2/0	Cu.....	96	24	24	32	8	650	1,658	21	1,040	5 disk.....	Jeffery-Dewitt.....	Double strings of 7	Jeffr
.....	Al. 19 Strands.....	84	25	30	35	5 min.....	525	1,800	18	550	7 type B.....	Ohio Brass.....	8 type B.....	Ohio

January 3, 1925

the United States At and

nsion Transmission Lines
nd the Development of Interconnection

TRICAL WORLD

Strain		Arcing Horns or None	Shield Rings or None	Towers					Normal (Per Cent)	Ro Sy Con
Units per	Manufacturer			Manufacturer	Wood, Concrete or Steel	Cross Arms—Steel or Wood	Pins—Steel or Wood	Tower Height, Feet to Lowest Conductor		No. Uni
	33	34	35	36	37	38	39	40	41	42
					Wood	Steel	Steel		10	
					Wood	Steel	Steel	18	10	
					Wood	Wood	Steel	18	10	
					Wood	Steel	Steel	18	10	
					Wood	Wood	Steel	18	10	
					Wood	Wood	Steel	18	10	
					Wood	Wood	Steel	18	10	
					Steel	Steel	Steel	18	10	
					Wood	Wood	Steel	18	10	
					Wood	Wood	Steel	18	10	
					Wood	Wood	Steel	18	10	
					Wood	Wood	Steel	18	10	
					Wood	Wood	Wood	18	10	
24	Thomas		No.	Milliken	Steel	Steel	Steel	50	10	
4	Ohio Brass	None	None		Wood	Steel			10	None
	Thomas or G. E.	Yes	None	Milliken	Steel	Steel	None	50		
	Thomas or G. E.	Yes	None	Milliken	Steel	Steel	None	50		
	Thomas or G. E.	Yes	None	Milliken	Steel	Steel	None	48½		
	Thomas or G. E.	Yes	None	Aermotor	Steel	Steel	None	49		
	Thomas			U. S. Wind Engine & Pump	Steel	Steel	2½ in. gal. steel	61½		
	Thomas or G. E.	Yes	None	Milliken	Steel	Steel	None	53		
	Thomas or G. E.	Yes	None	Milliken	Steel	Steel	None	53		
	Thomas or G. E.	Yes	None	Milliken	Steel	Steel	None	51		
	Thomas or G. E.	Yes	None	Milliken	Steel	Steel	None	51		
5					Wood	Wishbone		30	5	
5					Steel	Steel	Steel		5	
6					Steel	Steel	Steel		8	
5					Wood	Wishbone	Steel	30	5	
5					Wood	Wishbone		30	2	
6					Steel, bayonet type	Steel	Steel		2	
5					Wood	Wishbone	Steel	30	8	
9					Steel, horiz. type	Steel		45	10	
6					Wood pole, H frame	Steel			2	
4					Wood pole	Wishbone		30	2	
9					Wood pole, H frame	Steel		40	5	
5					Steel sq. towers	Steel		50	3	
6					Steel sq. towers	Steel		50	3	
7					Steel sq. towers	Steel		50	10	
5					Wood poles and flex. steel towers	Wood		30	5	
5					Wood pole	Wishbone		30	10	
7					Steel sq. towers	Steel		50	3	
6					Wood pole, H frame	Steel		35	2	
6					Steel sq. towers	Steel		50	3	
6					Steel sq. towers	Steel		50	5	
6					Steel A frame	Steel	Steel		3	
6	Locke & Pitts	Yes		Milliken	Steel	Steel		37		
6	Locke & Pitts	Yes		Milliken	Steel	Steel		37		
6	Locke & Pitts	Yes		Milliken	Steel	Steel		37		
6	Locke & Pitts	Yes		Milliken	Steel	Steel		37		
6	Locke	Yes		Blaw	Steel	Steel		44		
6	Hewlett	Yes		Blaw	Steel	Steel		44		
5	Thomas	Yes			Wood	Wood		44		
5	Locke	Yes			Wood	Wood		22		
6	Jeffrey-Dewitt	Yes		Milliken	Steel	Steel		49		
5	Locke	Yes			Wood	Wood		22		
6	Jeffrey-Dewitt	Yes		Milliken	Steel	Steel		45		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		46		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		46		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		34		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		36		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		36		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		46		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		46		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		46		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		46		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		46		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		36		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		36		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		46		
gs of 7	Jeffrey-Dewitt	Yes	No.	Blaw-Knox	Steel	Steel		46		
	Ohio Brass	No	No.	Milliken	Steel	Steel		44	10	None
					Steel	Steel		44	10	None

At and Above 44,000 Vol

Pins—or Wood 39	Tower Height, Feet to Lowest Conductor 40	Regulation: Normal (Per Cent) 41	Regulation: Synchronous Condensers, Kva.: No. of Units 42	Regulation: Synchronous Condensers, Kva.: Total Capacity 43	Regulation: P. F. at Normal Load 44	Arresters—Type: Bus 45	Arresters—Type: Lines 46	Arresters—Type: Transformers 47	Ground W: Material 48	Ground W: No. of Ground W 49
		10			90—95		Aluminum cell type			No ground
	18	10	1	3,000	80					
	18	10			80					
	18	10			80	Car. electrolyte				
	18	10			80	Sp. Fd. electrolyte				
	18	10			80					
	18	10			80	Mendon electrolyte				
	18	10			80	Pitts. electrolyte				
	18	10			80		Oxide Film			
	18	10			80					
	18	10			80					
	18	10			80					
							Port. type			
	18	10	1	2,500	80		Oxide film			
	50	10	1	7,500	80		Electrolytic		¾-in. gal. steel	Each tower
		10	None		75	Electrolytic			None	
	50								¾-in. gal. steel	Every tower
	50								¾-in. gal. steel	Every tower
	48½								¾-in. S. M.	Every tower
	49								¾-in. S. M.	Every tower
gal. steel	61½								¾-in. S. M.	Every tower
	53								¾ in. S. M.	Every tower
	53								¾-in. S. M.	Every tower
	51								¾ in. S. M.	Every tower
	51								¾ in. S. M.	Every tower
	30	5			80		Electro		Each cross-arm grounded	
		5			75		Electro		Gal. steel	
		8	1	7,500	85		Electro		No. 4 cop. clad	
	30	5			70		Electro		No. 6 cop. clad	
	30	2	1	7,500	90		Electro		Each cross-arm grounded	
		2	1	7,500	90		Electro		No. 4 cop. clad	
	30	8			95		Electro		Each cross-arm grounded	
	45	10			90		Oxide		$\frac{7}{16}$ in. cru. st	
		2			90		Electro		¾ in. steel	
	30	2			70		Electro		Each cross-arm grounded	
	40	5			95		Oxide		Each cross-arm grounded	
	50	3			70		Electro		$\frac{7}{16}$ in. steel	
	50	3			90		Electro		½ in. steel	
	50	10			85		Electro		¾ in. steel	
	30	5			70		Electro		$\frac{7}{16}$ in. steel	
	30	10			95		Electro		Each cross-arm grounded	
	50	3	2	17,500	90		Electro		½ in. steel	
	35	2			90		Electro		Each cross-arm grounded	
	50	3			90		Electro		$\frac{7}{16}$ in. steel	
	50	5			75		Electro		$\frac{7}{16}$ in. steel	
		3			80		Electro		½ in. steel	
	37				60—90				Steel strand	
	37				60—80				Steel strand	
	37				50—70				Steel strand	
	37		1	4,000	60—90				Steel strand	
	44								Steel strand	
	44								Steel strand	
	44		1	5,000	80—95				Steel strand	
	22								Steel strand	
	49								Steel strand	
	22								Steel strand	
	45								Steel strand	
	46				75		Oxide film		Copper weld	Every tower
	46				75		Oxide film		Copper weld	Every tower
	34				75		Oxide film		Steel	Every tower
	36		1	10,000	75		Ocide film		Steel	Every tower
	36				75		Oxide film		Steel	Every tower
	46				75		Oxide film		Copper weld	Every tower
	46				75		Oxide film		Copper weld	Every tower
	46		1	5,000	75		Auto valve		Copper weld	Every tower
	46				75		Auto valve		Copper weld	Every tower
	46				75		Auto valve		Copper weld	Every tower
	46				75		Auto valve		Copper weld	Every tower
	36				75		Oxide film		Copper weld	Every tower
	36				75		Oxide film		Copper weld	Every tower
	46				75		Oxide film		Copper weld	Every tower
	46				75		Oxide film		Copper weld	Every tower
	44	10	None		87	None	Electro	None	Steel	Every tower

olts

Ground Wire		Communication		Switching			
of Ground Wires 49	No. of Wires 50	Type 51	Location 52	H.T. 53	L.T. 54	Both H.T. and L.T. 55	Number of Line 56
No ground wire		Telephone	Under H.T. lines	Open air and oil	Disconnects a	nd oil	1
		Telephone		Oil circuit breaker	Oil circuit breaker		2
		Telephone		Oil circuit breaker	Oil circuit breaker		3
		Telephone		Oil circuit breaker	Oil circuit breaker		4
		Telephone		Air break and oil	Oil circuit breaker		5
		Telephone		Oil	Oil circuit breaker		6
		Telephone		Oil and air break	Oil circuit breaker		7
		Telephone		Oil and air break	Oil circuit breaker		8
		Telephone		Oil and air break	Oil circuit breaker		9
		Telephone		Oil and air break	Oil circuit breaker		10
		Telephone		Oil and air break	Oil circuit breaker		11
		Telephone		Oil and air break	Oil circuit breaker		12
		Telephone		Oil and air break	Oil circuit breaker		13
		Telephone		Oil and air break	Oil circuit breaker		14
tower	1	None				Yes	15
		None		Air break		Yes	16
y tower	1	Telephone	On tower				17
y tower	1	Telephone	On tower				18
y tower	1	Telephone	On tower				19
y tower	1	Telephone	On tower				20
y tower	1	Telephone	On tower				21
y tower	1	Telephone	On tower				22
y tower	1	Telephone	On tower				23
y tower	1	Carrier current					24
y tower	1						25
rounded		2-wire metallic		Yes			26
	1	None		Yes			27
	1	2-wire metallic		Yes			28
	1	2-wire metallic		Yes			29
rounded		2-wire metallic		Yes			30
	1	2-wire metallic		Yes			31
rounded		2-wire metallic		Yes			32
	1	2-wire metallic		Yes			33
	1	2-wire metallic		Yes			34
rounded		None		Yes			35
rounded		a		Yes			36
	1	2-wire metallic		Yes			37
	1	2-wire metallic		Yes			38
	1	2-wire metallic, also carrier current		Yes			39
	1	2-wire metallic		Yes			40
rounded		2-wire metallic		Yes			41
	1	2-wire metallic		Yes			42
rounded		None		Yes			43
	1	None		Yes			44
	1	None		Yes			45
	1	2-wire metallic		Yes			46
	1	Telephone				Yes	47
	1	Telephone				Yes	48
	1	Telephone				Yes	49
	1	Telephone				Yes	50
	1	Telephone				Yes	51
	1	Telephone				Yes	52
	1	Telephone				Yes	53
	1	Telephone				Yes	54
	1	Telephone				Yes	55
	1	Telephone				Yes	56
	1	Telephone				Yes	57
y tower	1	Commercial	S. N. E. T. Co	Yes			58
y tower		Commercial	S. N. E. T. Co	Yes			59
y tower	1	High tension	Towers	Yes			60
y tower	1	High tension	Towers	Yes			61
y tower	1	High tension	Towers	Yes			62
y tower	1	Commercial	S. N. E. T. Co	Yes			63
y tower		Commercial	S. N. E. T. Co	Yes			64
y tower	1	Commercial	S. N. E. T. Co	Yes			65
y tower		Commercial	S. N. E. T. Co	Yes			66
y tower	1	Commercial	S. N. E. T. Co	Yes			67
y tower		Commercial	S. N. E. T. Co	Yes			68
y tower	1	Commercial	S. N. E. T. Co	Yes			69
y tower		Commercial	S. N. E. T. Co	Yes			70
y tower	1	Commercial	S. N. E. T. Co	Yes			71
y tower		Commercial	S. N. E. T. Co	Yes			72
y tower		Commercial	S. N. E. T. Co	Yes			
y tower	1	2-wire metallic and carrier current	On wood poles			Yes	73

72	Derby—Tie Line	1923										
	Middle Atlantic States—(See end of tabulation for additional lines in this section)											
	Pennsylvania Wtr. & Pwr. Co.											
73	Holtwood—Baltimore (Circuits Nos. 1 and 2)	1910	.....	.....	h16,000	h40,000	h40,000	70,000	3	25	D	
74	Holtwood—Baltimore (Circuits Nos. 5 and 6)	No. 5—1917 No. 6—1914	.....	.....	h16,000	h40,000	h40,000	70,000	3	25	D	
75	Holtwood—Lancaster	...	.....	.....	h12,000	h25,000	h25,000	70,000	3	25	D	
76	Holtwood—York (Circuits Nos. 7 and 8)	1923	.....	.....	h5,000	h7,800	h20,000	70,000	3	60	D	
77	Holtwood—Coatesville (Circuits Nos. 9 and 10)	1923	.....	.....	h5,000	h7,800	h20,000	70,000	3	60	D	
78	Holtwood—Lancaster (Circuits Nos. 11 and 12)	1924	.....	.....	h15,000	h15,000	h30,000	70,000	3	60	D	
	Metropolitan Edison Co.											
79	Lebanon—Middletown	1920	32,500	202,500	10,000	20,000	10,000	66,000	3	60		
80	Pottsville—Reading	1920	85,000	85,000	10,000	20,000	10,000	66,000	3	60		
81	Reading—Lebanon	1920—22	77,500	77,500	10,000	20,000	10,000	66,000	3	60		
82	Reading—Easton	1923—24	105,000	105,000	40,000	60,000	40,000	k66,000	3	60		
83	Reading—Middletown	1923—24	105,000	275,000	40,000	60,000	40,000	k66,000	3	60		
84	Lebanon—Pinegrove	1922—23	27,500	152,500	5,000	10,000	.....	66,000	3	60		
85	Middletown—York Haven	1923	55,000	225,000	20,000	40,000	.....	66,000	3	60		
	Penn Central Lt. & Pwr. Co.											
86	Warrior Ridge—Altoona	1906 and 1909	10,000	10,000	10,000	10,000	10,000	45,000	3	60		
87	Altoona—Williamsburgh	1914 and 1920—21	21,250	21,250	25,000	25,000	25,000	45,000	3	60		
88	Summit—Ashville	1912	.....	.....	.....	.....	.....	45,000	3	60		
89	Moss Creek—Altoona	1912—17	.....	.....	.....	.....	.....	45,000	3	60		
90	Altoona—Summit	1912	.....	.....	.....	.....	.....	45,000	3	60		
91	Summit—Saxton	1923	25,000	80,000	.....	.....	.....	m45,000	3	60		
92	Saxton—Shade Gap	1923	.....	.....	.....	.....	.....	m45,000	3	60		
93	Shade Gap—Roxbury	1923	.....	.....	.....	.....	.....	45,000	3	60		
94	Roxbury—Shippinsburg	...	.....	.....	.....	.....	.....	13,200	3	60		
95	Lewistown—Shade Gap	1923	.....	.....	.....	.....	.....	m45,000	3	60		
96	Lewistown—Mt. Union	1909—10	.....	.....	.....	.....	.....	45,000	3	60		
97	Mt. Union—Warrior Ridge	1909—10	.....	.....	.....	.....	.....	45,000	3	60		
98	Lewistown—Warrior Ridge	1909—10	.....	.....	.....	.....	.....	45,000	3	60		
99	Summit—Vintondale	1912—19	.....	.....	.....	.....	.....	45,000	3	60		
100	Vintondale—Moss Creek	1921—23	.....	.....	.....	.....	.....	45,000	3	60		
101	Summit—Ebensburg	1923	.....	.....	.....	.....	.....	45,000	3	60		
102	Moss Creek—Glory	1922	.....	.....	7,500	.....	.....	45,000	3	60		
103	Cornpropst's—Bellfonte	1923	.....	.....	5,000	.....	.....	45,000	3	60		
	East Penn Electric Co.											
104	Pinegrove—Fishbach	....	n25,000	.....	.....	.....	.....	66,000	3	60	De	
105	Pinegrove—Lebanon	....	n25,000	.....	.....	.....	.....	66,000	3	60	De	
	Penn Public Service Corp.											
106	Seward—Glory	1921	50,000	100,000	10,000	20,000	20,000	66,000	3	60	Ye	
107	Glory—Piney	1923—24	50,000	100,000	10,000	20,000	20,000	110,000	3	60	Ye	
108	Seward—Hooversville	1922	50,000	100,000	10,000	20,000	20,000	110,000	3	60	Ye	
109	Piney—Union City	1924	50,000	100,000	10,000	10,000	20,000	110,000	3	60	Ye	
	Duquesne Light Company											
110	Ambridge—Wacht Jt. No. 1	1916	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
111	Ambridge—Wacht Jt. No. 2	1916	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
112	Brunot Is.—Ambridge No. 1	1916	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
113	Brunot Is.—Ambridge No. 2	1916	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
114	Brunot Is.—Woodville No. 1	1919	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
115	Brunot Is.—Woodville No. 2	1919	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
116	Colfax—North No. 1	1916	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
117	Colfax—North No. 2	1922	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
118	Colfax—Wilmerding No. 1	1921	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
119	Colfax—Wilmerding No. 2	1921	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
120	Colfax—Dravosburg No. 1	1922	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
121	Colfax—Dravosburg No. 2	1922	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
122	North—Wacht Jt. No. 1	1916	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
123	North—Wacht Jt. No. 2	1922	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
124	Wacht Jt.—Junction Pk. No. 1	1916	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
125	Wacht Jt.—Junction Pk. No. 2	1916	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
126	Wilmerding—Dravosburg No. 1	1921	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
127	Wilmerding—Dravosburg No. 2	1921	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
128	Woodville—Dravosburg No. 1	1921	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
129	Woodville—Dravosburg No. 2	1921	q240,000	.....	22,000	30,000	.....	66,000	3	60	Sta	
	Philadelphia Electric Co.											
130	Schuylkill Stat.—Chester Stat	....	158,000	158,000	30,000	80,000	.....	r66,000	3	60	De	
	United Hudson Elec. Ry.											
131	Hudson—Poughkeepsie	1920	36,000	36,000	20,000	30,000	20,000	66,000	3	60		
132	Catskill—So. Bethlehem	1922	s	s	20,000	30,000	50,000	t66,000	3	60		
133	Ohioville—E. Walden	1923	None	None	20,000	30,000	50,000	t66,000	3	60		
	Utica Gas & Elec. Co.											
134	Utica—Little Falls	1907	.....	.....	.....	.....	.....	u44,000	3	60		
135	Rome—Trenton Falls	1913	26,000	.....	12,500	12,500	12,500	44,000	3	60		
136	Trenton Falls—Utica	HH 1902—17	26,000	.....	15,300	15,300	15,300	44,000	3	60		
137	Utica—Taylorville	1922	50,000	.....	25,000	25,000	50,000	66,000	3	60		
138	Utica—Lemquoit	1921	.....	.....	.....	.....	.....	u44,000	3	60		
	Niagara Falls Power Co.											
139	Echota—Buffalo	1921	600,000	.....	50,000	100,000	.....	60,000	3	25		
140	Echota—Saunders	1922	600,000	.....	40,000	80,000	.....	60,000	3	25		
141	Echota—Gardenville	1924	600,000	.....	40,000	80,000	.....	60,000	3	25		
	Adirondack Pwr. & Lt. Co.											
142	Rotterdam—Catskill	1922	v	v	10,000	15,000	15,000	t66,000	3	60		
143	Inghams—Little Falls	1918	v	v	10,000	15,000	15,000	66,000	3	60		
144	Utica-Inghams Mills	1921—22	v	v	10,000	15,000	15,000	66,000	3	60		
145	Inghams Mills—Tribes Hill	1911—12	15,500	27,500	5,000	8,000	8,000	66,000	3	60		
146	Utica—Clark Mills	1906	v	v	10,000	15,000	15,000	66,000	3	60		
147	Sherman Is.—Rotterdam	1922	45,000	.....	30,000	45,000	45,000	110,000	3	60		
148	Amsterdam—Inghams	1918	Line not in use	.....	.....	.....	.....	66,000	3	60		
149	Tribes Hill—Rotterdam	1921	15,500	27,500	10,000	15,000	15,000	66,000	3	60		
150	Clark Mills—Oneida	1918	.....	.....	10,000	15,000	15,000	66,000	3	60		
151	Spier Falls—Glens Falls	1924	7,500	7,500	10,000	15,000	15,000	66,000	3	60		
152	Rotterdam—No. Albany	1923	.....	.....	30,000	45,000	45,000	110,000	3	60		
153	No. Albany—Adams	1923	.....	.....	30,000	45,000	45,000	110,000	3	60		
	West Penn Company	1918										
154	Windsor—Washington	1920	90,000	90,000	40,000	60,000	60,000	z66,000	3	60	Del	
155	Washington—Charleroi	1923	.....	.....	40,000	60,000	60,000	z66,000	3	60		
156	Springdale—Crows Nest	1920	42,000	300,000	30,000	40,000	60,000	z25,000	3	60	Del	
157	Springdale—Kittanning	1923	42,000	300,000	40,000	60,000	60,000	z66,000	3	60	Del	
158	Springdale—Charleroi	1924	42,000	300,000	40,000	60,000	60,000	z66,000	3	60	Del	
159	Charleroi—Cheat Haven	1924	.....	.....	40,000	60,000	60,000	z66,000	3	60		
160	Rivesville—Morgantown	1924	40,000	100,000	15,000	30,000	30,000	66,000	3	60	Del	
161	Morgantown—Cheat Haven	1924	.....	.....	15,000	30,000	30,000	66,000	3	60	Del	
162	Cheat Haven—Howesville	1923	.....	.....	20,000	30,000	30,000	66,000	3	60		
163	Howesville—Oakland	1923	.....	.....	20,000	30,000	30,000	66,000	3	60		
164	Howesville—Grafton	1923	.....	.....	20,000	30,000	30,000	66,000	3	60		
165	Rivesville—Grafton	1923	40,000	100,000	20,000	30,000	30,000	66,000	3	60		
166	Rivesville—Hutchinson	1919	40,000	100,000	15,000	15,000	15,000	66,000	3	60	Del	
167	Grafton—Flemington	1923	.....	.....	20,000	30,000	30,000	66,000	3	60	Del	
	Keystone Power Corp.											
168	Jackson Tap—Bellefonte	1923	4,500	.....	5,000	10,000	.....	44,000	3	60		
169	Durant City-Kane	1920	20,225	.....	7,500	15,000	.....	44,000	3	60	Del	
	Niagara, Lockport and Ont. Pwr. Co.							Q-Q				
170	Ontario Sta.—Lockport	1906	.....	.....	.....	.....	.....	60,000	3	25	Star	
171	Echota Sta.—Lockport	1921	.....	.....	.....	.....	.....	60,000	3	25	Star	
172	Echota Sta.—Tap Line	1916	.....	.....	.....	.....	.....	60,000	3	25	Star	
173	Echota Sta.—Gardenville	1923	.....	.....	.....	.....	.....	60,000	3	25	Star	
174	Lockport—Gardenville	1908	.....	.....	.....	.....	.....	60,000	3	25	Star	
175	Gardenville—Lackawanna	1908	.....	.....	.....	.....	.....	60,000	3	25	Star	
176	Gardenville—Dunkirk	1920	.....	.....	.....	.....	.....	60,000	3	25	Star	
177	Gardenville—Olean	1923	.....	.....	.....	.....	.....	60,000	3	25	Star	
178	Farmingdale—Falconer	1922	.....	.....	.....	.....	.....	60,000	3	25	Star	
179	Lockport—Mortimer	1906	.....	.....	.....	.....	.....	60,000	3	25	Star	
180	Lockport—Mortimer	1924	.....	.....	.....	.....	.....	60,000	3	25	Star	
181	Lockport—Batavia	1906	.....	.....	.....	.....	.....	60,000	3	25	Star	
182	Batavia—Mortimer Jct	1906	.....	.....	.....	.....	.....	60,000	3	25	Star	
183	Mortimer Jct.—Mortimer	1906	.....	.....	.....	.....	.....	60,000	3	25	Star	
184	Mortimer—Throop	1907	.....	.....	.....	.....	.....	60,000	3	25	Star	
185	Throop—Solvay	1906	.....	.....	.....	.....	.....	60,000	3	25	Star	
186	Throop—Solvay	1924	.....	.....	.....	.....	.....	60,000	3	25	Star	
187	Mortimer—Lyons	1906	.....	.....	.....	.....	.....	60,000	3	25	Star	
188	Lyons—Throop	1906	.....	.....	.....	.....	.....	60,000	3	25	Star	
189	Solvay—Salmon R	1914	.....	.....	.....	.....	.....	60,000	3	25	Star	
190	Fairport—Tap	1920	.....	.....	.....	.....	.....	60,000	3	25	Star	
191	Throop—Auburn	1907	.....	.....	.....	.....	.....	60,000	3	25	Star	
192	Batavia—Tap	1907	.....	.....	.....	.....	.....	60,000	3	25	Star	
193	Dunkirk—Westfield Jct	1909	.....	.....	.....	.....	.....	60,000	3	25	Star	
194	Westfield Jct.—Mayville	1913	.....	.....	.....	.....	.....	60,000	3	25	Star	
195	Throop Tap	1920	.....	.....	.....	.....	.....	60,000	3	25	Star	
196	Mortimer—Golah	1924	.....	.....	.....	.....	.....	60,000	3	25	Star	
197	Mortimer—Avon	1907	.....	.....	.....	.....	.....	60,000	3	25	Star	
198	Avon—Perry Jct	1923	.....	.....	.....	.....	.....	60,000	3	25	Star	
199	Perry Jct.—Perry	1923	.....	.....	.....	.....	.....	60,000	3	25	Star	
200	Echota Sta.—Echota Jct	1923	.....	.....	.....	.....	.....	60,000	3	25	Star	
201	Westfield Jct.—Westfield	1909	.....	.....	.....	.....	.....	60,000	3	25	Star	
202	Westfield Jct.—Erie	1909	.....	.....	.....	.....	.....	60,000	3	25	Star	
	South Atlantic States											
	Appalachian Power Co.											
203	Bluefield—Wytheville	L-L 1912	.....	.....	.....	.....	.....	88,000	3	60		
204	Wytheville—Byllesby	L-L 1912	.....	.....	.....	.....	.....	88,000	3	60		
205	Bluefield—Switchback	M-M 1912	.....	.....	.....	.....	.....	88,000	3	60		
206	Bluefield—Switchback	1912	.....	.....	.....	.....	.....	88,000	3	60		
207	Bluefield—Linkous Ferry	1912	.....	.....	.....	.....	.....	88,000	3	60		
208	Glen Lyn—Switchback	1918	.....	.....	.....	.....	.....	88,000	3	60		
209	Switchback—Coalwood	M-M 1913	.....	.....	.....	.....	.....	88,000	3	60		
210	Switchback—Mullens	1914	.....	.....	.....	.....	.....	88,000	3	60		
211	Coalwood—Moss	1922—23	.....	.....	.....	.....	.....	88,000	3	60		
212	Coalwood—Coal Creek	1922—23	.....	.....	.....	.....	.....	88,000	3	60		
213	Glen Lyn—Pulaski	1922	.....	.....	.....	.....	.....	88,000	3	60		
214	Byllesby—Sollville	1922	.....	.....	.....	.....	.....	88,000	3	60		
215	Byllesby—Roanoke	1912	.....	.....	.....	.....	.....	88,000	3	60		
	Virginia Railway & Power Co.											
216	Richmond—Petersburg	N-N 1910—13	116,750	144,250	10,000	15,000	15,000	110,000	3	60		
217	Petersburg—Suffolk	1917—18	116,750	144,250	10,000	15,000	15,000	110,000	3	60		

25	Delta Star	Delta Star		50 ohms	Holtwood		2	.40	300,000 C. M.	Al. 19 Strands	
25	Delta Star	Delta Star		50 ohms	Holtwood		2	.40	300,000 C. M.	Al. 19 Strands	
25	Delta Star	Delta Delta		50 ohms	Holtwood		2	.14	No. 0	Cu	
60	Delta Star	Delta Star	Solid	50 ohms	Holtwood		2	.23	No. 00	Cu	
60	Delta Star	Delta Star	Solid	50 ohms	Holtwood		2	.29	No. 00	Cu	
60	Delta Star	Delta Star	Solid	50 ohms	Holtwood		2	.15	No. 00	Cu	
60	13,200 to 66,000	66,000 to 2,300	Yes	15,000	Reading		2	20.5	4/0	A. C. S. R.	
60	13,200 to 66,000	66,000 to 2,300	Yes	15,000	Reading		1	30.4	250,000 C. M.	Bare H. D. Cu	
60	13,200 to 66,000	66,000 to 2,300	Yes	15,000	Reading		2	26.8	2/0	Bare H. D. Cu	
60	13,200 to 66,000	66,000 to 2,300	Yes	15,000	Reading		2	47.4	336,400 C. M.	A. C. S. R.	
60	13,200 to 66,000	66,000 to 2,300	Yes	15,000	Reading		1	48.4	4/0	A. C. S. R.	
60	13,200 to 66,000	66,000 to 2,300	Yes	15,000	Reading		1	15.9	No. 1	Bare H. D. Cu	
60	13,200 to 66,000	66,000 to 2,300	Yes	15,000	Reading		2	6.3	4/0	A. C. S. R.	
60	2,300 to 45,000	45,000 to 6,600	Yes		Warrior Ridge		2	58.0	No. 2 B & S	Cu	
60	6,900 to 45,000	45,000 to 6,600	Yes		Williamsburg	1—Two sets of towers		22.8	No. 1—Cu.—1/0—Al	Cu and Al	
60		45,000 to 2,300	No				1	6.53	1/0	Cu	
60		45,000 to 6,600	No				1	31.34	No. 2 Cu.—1/0-Cu.—3/0-Al	Cu. and Al.	
60			No				1	12.6	No. 2	Cu	
60	13,500 to 45,000	45,000 to 13,200	Yes		Saxton		2	50	4/0	Cu	
60		45,000 to 13,200	No				2	36	250,000 C. M.	Cu	
60		45,000 to 13,200	No	No			1	12	4/0	Al. S. R.	
60		13,200 to 2,300	No	No			1	12			
60		110,000 to 6,600	Yes	No	Lewistown		2	76	250,000 C. M.	Cu	
60		45,000 to 220	Yes	No	Lewistown		1	22.63	1/0	Cu	
60		45,000 to 2,300	No	No			1	15.75	No. 1	Cu	
60		45,000 to 2,300	Yes	No	Lewistown		1	31.0	No. 1	Cu	
60		45,000 to 2,300	No	No			1	26.0	No. 2 and 1/0	Cu	
60			No	No			1	12.5	No. 2	Cu	
60		45,000 to 13,200	No	No			1	12.5	1/0	Cu	
60	45,000 to 66,000		No	No			1	4.5	1/0	Cu	
60		45,000 to 22,000	No	No			1	12.0	1/0	Cu	
60	Delta Star	Delta Star	Main gener. only	No			2	14.5	4/0	Cu	
60	Delta Star	*P*		No			1	12.0	No. 1-2/0	Cu	
60	Yes	Yes	Yes	None	Seward		2	37	2/0	Cu	
60	Yes	Yes	Yes	None	Piney		2	97	4/0	A. C. S. R.	
60	Yes	Yes	Yes	None	Seward		2	37	4/0	A. C. S. R.	
60	Yes	Yes	Yes	None	Piney		1	54	2/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	2.69	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	2.69	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	15.19	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	15.19	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	9.31	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	9.31	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	12.65	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	12.68	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	9.88	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	9.88	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	15.14	4/0	3/4 Cu.—1/4 Al	
60	Star Star	Delta Star		3.75 ohms	Station		2	15.14	4/0	3/4 Cu.—1/4 Al	
60	Star Star	Delta Star		3.75 ohms	Station		2	14.71	4/0	Cu	
60	Star Star	Delta Satr		3.75 ohms	Station		2	14.71	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	11.07	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	11.07	4/0	Cu	
60	Star Star	Delta Star		3.75 ohms	Station		2	5.26	4/0	1/3 Cu.—2/3 Al	
60	Star Star	Delta Star		3.75 ohms	Station		2	5.26	4/0	1/3 Cu.—2/3 Al	
60	Star Star	Delta Star		3.75 ohms	Station		2	11.88	4/0	Al	
60	Star Star	Delta Star		3.75 ohms	Station		2	11.88	4/0	Al	
60	Delta Delta	Delta Delta	Isolated				2	28	2/0	Cu	
60			1		Rifton		2	47	1/0	Cu	
60			None				2	22	4/0	Cu	
60			None				2	13.5	4/0	Cu	
60			Delta	Delta			2	30	2/0	Cu	
60	1	2	Delta	Delta			1	15.5	1/0	Cu	
60	1	1	Delta	Delta			1	12.6	1/0	Cu	
60	1	1					2	64	4/0	Cu	
60			Delta	Delta			2	15	2/0	Cu	
25	12,000	11,000		720 ohms	Echota		2	21.2	500,000 C. M.	Cu	
25	12,000			720 ohms	Echota		2	9.4	350,000 C. M.	Cu	
25	12,000			720 ohms	Echota		2	28.4	350,000 C. M.	Cu	
60			Yes		Rotterdam		2	45.0	4/0	Cu	
60			Yes				1	9.6	3/0	Cu	
60			Yes		Utica		1	26.8	4/0	Cu	
60			Yes				2	28.5	No. 2	Cu	
60			Yes		Utica		2	8.4	3/0	Cu	
60			Yes		Sherman Island		2	36.6	4/0	Cu	
60							1	35.4	3/0	Cu	
60			Yes		Rotterdam and Amsterdam		2	18.0	4/0	Cu	
60			Yes		Utica		1	14.3	1	A. C. S. R.	
60			Yes		Glens Falls		1	9.6	3/0	Cu	
60			Yes		Rotterdam No. Alb		1	19.1	4/0	Cu	
60			Yes		No. Alb. Adams		1	40.5	4/0	Cu	
60	Delta Star	Delta Star	Yes	28.8	Terminals		2	52.2	4/0	Hard drawn st. cu.	Vert. 162.
60		Delta Star	No	28.8	Charleroi		2	34.0	4/0	Standard copper	Horiz. 264
60	Delta Star		No	28.8			2	35.7	4/0	Standard copper	Horiz. 264
60	Delta Star	Delta Star	Yes		Terminals		2	47.2	4/0	Standard copper	Horiz. 264
60		Delta Star	Yes	28.8	Terminals		2	62.7	4/0	Standard copper	Horiz. 264
60		Delta Star	No	28.8	Terminals		2	30.4	4/0	Standard copper	Horiz. 264
60	Delta Star		Yes		Riverville		2	20.9	4/0	Standard copper	
60	Delta Star		Yes				2	17.7	4/0	Standard copper	
60		Delta Star					1	20.8	4/0	Standard copper	
60							1	20.1	4/0	Standard copper	
60		Delta Delta					1	19.2	4/0	Standard copper	
60	Delta Star		Yes		Rivesville		1	13.6	4/0	Standard copper	
60	Delta Star	Star Delta	Yes		Rivesville		1	11.1	No. 2	Standard copper	
60		Star Delta					1	8.2	4/0	Standard copper	
60		Delta Delta					1	13.5	1/0	Str. bare Cu	
60	Delta Delta	Delta Delta					2	54	No. 2	Solid bare Cu	
25	Star		Yes	1,000 ohms	Generating plant		2	33.6	642,000	Al	
25	Star		Yes	1,000 ohms	Generating plant		2	30.4	400,000	Cu	
25	Star		Yes	1,000 ohms	Generating plant		1	4.3	105,534	Cu	
25	Star		Yes	1,000 ohms	Generating plant		2	24.4	556,500	Al	
25	Star		Yes	1,000 ohms	Generating plant		2	42.8	250,000	Cu	
25	Star		Yes	1,000 ohms	Generating plant		2	11.8	250,000	Cu	
25	Star		Yes	1,000 ohms	Generating plant		2	82.4	211,600	A. C. S. R.	
25	Star		Yes	1,000 ohms	Generating plant		2	139.8	336,400	A. C. S. R.	
25	Star		Yes	1,000 ohms	Generating plant		2	58.0	211,600	A. C. S. R.	
25	Star		Yes	1,000 ohms	Generating plant		1	55.7	428,000	Al	
25	Star		Yes	1,000 ohms	Generating plant		2	111.4	397,500	A. C. S. R.	
25	Star		Yes	1,000 ohms	Generating plant		1	24.3	428,000	Al	
25	Star		Yes	1,000 ohms	Generating plant		1	21.4	428,000	Al	
25	Star		Yes	1,000 ohms	Generating plant		1	11.2	428,000	Al	
25	Star		Yes	1,000 ohms	Generating plant		2	123.2	336,400	A. C. S. R.	
25	Star		Yes	1,000 ohms	Generating plant		1	19.2	556,500	Al	
25	Star		Yes	1,000 ohms	Generating plant		2	38.4	336,400	A. C. S. R.	
25	Star		Yes	1,000 ohms	Generating plant		1	39.2	556,500	Al	
25	Star		Yes	1,000 ohms	Generating plant		1	25.2	556,500	Al	
25	Star		Yes	1,000 ohms	Generating plant		2	82.4	211,600	Cu	
25	Star		Yes	1,000 ohms	Generating plant		2	2.6	214,000	Al	
25	Star		Yes	1,000 ohms	Generating plant		1	4.1	214,000	Al	
25	Star		Yes	1,000 ohms	Generating plant		1	8.3	133,079	Cu	
25	Star		Yes	1,000 ohms	Generating plant		1	14.9	66,373	Cu	
25	Star		Yes	1,000 ohms	Generating plant		1	8.6	41,742	Cu	
25	Star		Yes	1,000 ohms	Generating plant		1	2.7	1-inch	S. M. D. G. Steel	
25	Star		Yes	1,000 ohms	Generating plant		1	10.4	214,000	Al	
25	Star		Yes	1,000 ohms	Generating plant		1	14.5	41,742	Cu	
25	Star		Yes	1,000 ohms	Generating plant		1	12.3	214,000	Al	
25	Star		Yes	1,000 ohms	Generating plant		1	9.0	214,000	Al	
25	Star		Yes	1,000 ohms	Generating plant		2	18.6	400,000	Cu	
25	Star		Yes	1,000 ohms	Generating plant		1	3.5	41,742	Cu	
25	Star		Yes	1,000 ohms	Generating plant		1	33.5	66,373	Cu	
60			Yes		Two points		1	24.9	1/0	Cu	
60			Yes		Two points		1	13.2	1/0	Cu	
60			Yes		Two points		1	10.9	1/0	Cu	
60			Yes		Two points		1	10.9	1/0	Al	120 Hori
60			Yes		Two points		1	38.3	1/0	Al	120 Hori
60			Yes		Two points		1	28.8	1/0	Cu	
60			Yes		Two points		2	31.9	1/0	Cu	
60			Yes		Two points		1	15.1	1/0	Cu	
60			Yes		Two points		1	44.4	1/0	Cu	
60			Yes		Two points		1	24.1	1/0	Cu	
60			Yes		Two points		1	25.1	1/0	Cu	
60			Yes		Two points		1	94.0	1/0	Al	
60			Yes		Two points		1	70.4	1/0	Cu	120 Hor
60			Yes		Two points						
60	Star	Delta	Yes	None	Richmond		1	25	1/0	Cu	
60	Star	Delta	Yes	None			1	66	1/0	Cu	
60	Star	Delta	Yes	None	Norfolk		2	17	2/0	Cu	
							1	36	4/0	A. C. S. R.	
							1	68	1/0	Al	

	2	j40	300,000 C. M.		Al. 19 Strands		84	25	30	35	5 min.	525	1,800	18	550	7 type B
	2	j40	300,000 C. M.		Al. 19 Strands		108	25	30	35	5 min.	525	1,800	18	550	7 type B
	2	j14	No. 0		Cu		84	25	30	35	5 min.	600		27	535	7 susp. t
	2	j23	No. 00		Cu		120	25	30	35	5 min.	650	1,800	22	1,000	7 susp. t
	2	j29	No. 00		Cu		120	25	30	35	5 min.	650	1,700	22	1,000	7 susp. t
	2	j15	No. 00		Cu		120	25	30	35	5 min.	650	1,700	22	1,000	7 susp. t
	2	20.5		4/0	A. C. S. R.		48	28	28	30		180	200	0.8	1,500	Pin
	1	130.4	250,000 C. M.		Bare H. D. Cu		60	28	28	30		175	200	1.9	1,500	Pin
	2	28.8		2/0	Bare H. D. Cu		48	28	28	30		150	175	1.2	1,000	Pin
	2	47.4	336,400 C. M.		A. C. S. R.		60	27	30	35		884	2,360	19.0	2,700	
	1	48.4		4/0	A. C. S. R.		156	27	30	30		662	1,595	9.8	1,650	
	1	115.9	No. 1		Bare H. D. Cu		48	29	29	35		175	200	0.99	1,000	Pin
	2	6.3		4/0	A. C. S. R.		120	27	30	35		721	2,136	11.6	1,650	
	2	58.0	No. 2 B & S		Cu		72	20 min.	27 min.	38 min.	8	500	640	8.0		1 pin.
1—Two sets of towers		22.8	No. 1—Cu.—1/0—Al		Cu and Al		72	20 min.	27 min.	38 min.	8	300	300	4 Cu., 7 Al.		1 pin.
	1	6.53		1/0	Cu		72	20 min.	24 min.	38 min.	7	200	200	3.5		1 pin.
	1	31.34	No. 2 Cu.—1/0-Cu.—3/0-Al		Cu. and Al		72	20 min.	24 min.	38 min.	7	175	200	3.0		1 pin.
	1	12.6	No. 2		Cu		72	20 min.	24 min.	38 min.	7	200	200	3.5		1 pin.
	2	50		4/0	Cu		120	20 min.	27 min.	40		500	3,000	7.5		
	2	36	250,000 C. M.		Cu		120	20 min.	27 min.	40		500	2,275	8.0		
	1	12		4/0	Al. S. R.		72	20 min.	27 min.	38 min.		300	2,250	2.5		1 pin.
	1	12														
	2	76	250,000 C. M.		Cu		120	20	27	40	none	500	2,275	8.0		
	1	22.63		1/0	Cu		72	20 min.	24 min.	38 min.	7	200	200	3.0		1 pin.
	1	15.75	No. 1		Cu		72	20 min.	24 min.	38 min.	7	200	200	3.0		
	1	31.0	No. 1		Cu		52	22	27	38	7	175	175	3.0		1 pin.
	1	26.0	No. 2 and 1/0		Cu		72	22	27	38	7	200	200	3.0		1 pin.
	1	12.5	No. 2		Cu		72	22	27	38	7	300	300	4.5		1 pin.
	1	12.5		1/0	Cu		72	22	27	38	7	250	250	4.0		1 pin.
	1	4.5		1/0	Cu		72	22	27	38	7	175	175	3.0		1 pin.
	1	12.0		1/0	Cu		72	22	27	38	7	200	200	3.5		1 pin.
	2	14.5		4/0	Cu		90	32.5	42.5	39.0	20	560	940	21	3,000	
	1	12.0	No. 1-2/0		Cu		64	23.3	21.9	30.9	12	150	400	1.1	1,500	Pin
	2	37		2/0	Cu		96	26	26	30 to 40	8	693	1,425	24.3	1,000	
	2	97		4/0	A. C. S. R.		120	26	26	30 to 40		1,257	2,290	48.0	1,200	
	2	37		4/0	A. C. S. R.		120	26	26			962	2,395	28.0	1,200	
	1	54		2/0	Cu		144	22	22 to 30	30 to 40		540	2,045	13.8	1,080	
	2	2.69		4/0	Cu		90	25 min.	31 min.	31 min.		678	1,129.5	29.6		6 strain
	2	2.69		4/0	Cu		90	25 min.	31 min.	31 min.		678	1,129.5	29.6		6 strain
	2	15.19		4/0	Cu		90	25 min.	31 min.	31 min.		663	1,651	29.6		6 strain
	2	15.19		4/0	Cu		90	25 min.	31 min.	31 min.		663	1,651	29.6		6 strain
	2	9.31		4/0	Cu		90	25 min.	31 min.	31 min.		745	1,760	30		6 strain
	2	9.31		4/0	Cu		90	25 min.	31 min.	31 min.		745	1,760	30		6 strain
	2	12.65		4/0	Cu		90	25 min.	31 min.	31 min.		655	1,282	29.6		6 strain
	2	12.68		4/0	Cu		90	25 min.	31 min.	31 min.		655	1,282	29.6		6 strain
	2	9.88		4/0	Cu		90	25 min.	31 min.	31 min.		902	2,230.5	38.3		6 strain
	2	9.88		4/0	Cu		90	25 min.	31 min.	31 min.		902	2,230.5	38.3		6 strain
	2	15.14		4/0	3/4 Cu.—1/4 Al.		90	25 min.	31 min.	31 min.		880	2,303	31		6 strain
	2	15.14		4/0	3/4 Cu.—1/4 Al.		90	25 min.	31 min.	31 min.		880	2,303	31		6 strain
	2	14.71		4/0	Cu		90	25 min.	31 min.	31 min.		682	1,590	29.6		6 strain
	2	14.71		4/0	Cu		90	25 min.	31 min.	31 min.		682	1,590	29.6		6 strain
	2	11.07		4/0	Cu		90	25 min.	31 min.	31 min.		523	1,390	19.6		6 strain
	2	11.07		4/0	Cu		90	25 min.	31 min.	31 min.		523	1,390	19.6		6 strain
	2	5.26		4/0	1/3 Cu.—2/3 Al.		90	25 min.	31 min.	31 min.		842	2,303	31		6 strain
	2	5.26		4/0	1/3 Cu.—2/3 Al.		90	25 min.	31 min.	31 min.		842	2,303	31		6 strain
	2	11.88		4/0	Al		90	25 min.	31 min.	31 min.		647	1,123	29.6		6 strain
	2	11.88		4/0	Al		90	25 min.	31 min.	31 min.		647	1,123	29.6		6 strain
	2	28		2/0	Cu		90	36	50	50		500	590	12	1,070	
	2	47		1/0	Cu		90	23	30	30	5	530	750			
	2	22		4/0	Cu		114	23	30	30	5	660	850		5,000	
	2	13.5		4/0	Cu		114	23	30	30	5	660	850		5,000	
	2	30		2/0	Cu		60	30	36	36	6	150	240	7	1,100	1 pin.
	1	15.5		1/0	Cu		48	36	36	36		400	550	12	2,200	1 pin.
	1	12.6		1/0	Cu		48	36	36			400	550	12	2,200	1 pin.
	2	64		4/0	Cu		120	50	50	50		550	700	14	3,000	Link
	2	15		2/0	Cu		60	30	36	36		150	240	7	1,100	Pin
	2	21.2	500,000 C. M.		Cu		84	23.0	30	35	19	530	1,800	17.0	6,500	
	2	9.4	350,000 C. M.		Cu		120	23.5	33	36	15	430	469	15.5	3,500	
	2	28.4	350,000 C. M.		Cu		96 and 111	28.0	35	37	20	400	513	12.0	4,000	
	2	45.0		4/0	Cu		114	22.5	25	34	8	660	1,080	20.2	1,760	
	1	9.6		3/0	Cu		72	24	25	31	6	270	358	4.0	1,500	Pin
w1	2	26.8		4/0	Cu		84	29	29	31	8.5	500	997	10.0	2,000	
	2	28.5	No. 2		Cu		72	25	25	31	9	600	933	17.0	400	Pin
	2	8.4		3/0	Cu		72	32	32	32	9	550	600	18.0	2,000	Pin
	2	36.6		4/0	Cu		114	22.5	25	34	9	660	1,100	20.2	1,760	
	1	35.4		3/0	Cu		72	24	25	31	6	270	608	4	1,500	Pin
	2	18.0		4/0	Cu		84	29	29	31	7.5	500	1,513	10	2,000	
	1	14.3		1	A. C. S. R.		72	27	27	31	6.5	250	390	4	250	Pin
	1	9.6		3/0	Cu		68	18	25	31	None	175	678	4.3	580	
w1	1	19.1		4/0	Cu		114	22.5	25	34	8	660	928	20.2	1,760	
	1	40.5		4/0	Cu		150	22 to 24	25	34		375	Y665	7.9	1,490	
	2	52.2		4/0	Hard drawn st. cu		Vert. 162	36 min.	40	50	12 and 20	545 aver.	1,100		2,100+	9 or 10
	2	34.0		4/0	Standard copper		Horiz. 264 and 324	36 min.	40	50	12 and 20	586 aver.	1,370		2,100+	9 or 10
	2	35.7		4/0	Standard copper		Horiz. 264 and 324	36 min.	40	50	12 and 20	595 aver.	1,450		2,100+	10 disc
	2	47.2		4/0	Standard copper		Horiz. 264 and 324	36 min.	40	50	12 and 20	630 aver.	1,875		2,100+	9 disc
	2	62.7		4/0	Standard copper		Horiz. 264 and 324	36 min.	40	50	12 and 20	665 aver.	1,700		2,100+	9 disc
	2	38.4		4/0	Standard copper		Horiz. 264 and 324	36 min.	40	50	12 and 20	630 aver.	1,740		2,100+	9 disc
	2	20.9		4/0	Standard copper		84	25	28	40	10	738 aver.	1,593			5 sus
	2	17.7		4/0	Standard copper		84	25	28	40	10	667 aver.	1,885			5 sus
	1	20.8		4/0	Standard copper		105	25	30	40	10	475 aver.	4,340		2,100+	
	1	20.1		4/0	Standard copper		105	25	30	40	10	460 aver.	1,400		2,100+	4 or 5
	1	19.2		4/0	Standard copper		105	25	30	40	10	515 aver.	1,680		2,100+	4 or 5
	1	13.6		4/0	Standard copper		105	25	30	40	10	455 aver.	1,470		2,100+	
	1	11.1		No. 2	Standard copper		96	25	30	40	10	308 aver.			2,100+	
	1	8.2		4/0	Standard copper		105	25	30	40	10	530 aver.	1,340		2,100+	
	1	13.5		1/0	Str. bare Cu		54	30	35	35	10	175	200	1.5	2,000	1 pin
	2	54		No. 2	Solid bare Cu		52	26	31	30	9	250	250	2.5	1,500	1 pin
	2	33.6		642,000	Al			25 min.	30		8	500 to 600				7 sus
	2	30.4		400,000	Cu			25 min.	30		8	500 to 600				7 sus
	1	4.3		105,534	Cu			25 min.	30		8	500 to 600				7 sus
	2	24.4		556,500	Al			25 min.	30		8	500 to 600				7 sus
	2	42.8		250,000	Cu			25 min.	30		8	500 to 600				5 sus
	2	11.8		250,000	Cu			25 min.	30		8	500 to 600				5 sus
	2	82.4		211,600	A. C. S. R.			25 min.	30		8	500 to 600				7 sus
	2	139.8		336,400	A. C. S. R.			25 min.	30		8	500 to 600				7 sus
	2	58.0		211,600	A. C. S. R.			25 min.	30		8	500 to 600				7 sus
	1	55.7		428,000	Al			25 min.	30		8	500 to 600				7 sus
	2	111.4		397,500	A. C. S. R.			25 min.	30		8	500 to 600				7 sus
	1	24.3		428,000	Al			25 min.	30		8	500 to 600				7 sus
	1	21.4		428,000	Al			25 min.	30		8	500 to 600				Pin
	1	11.2		428,000	Al			25 min.	30		8	500 to 600				Pin
	2	123.2		336,400	A. C. S. R.			25 min.	30		8	500 to 600				7 sus
	1	19.2		556,500	Al			25 min.	30		8	500 to 600				7 sus
	2	38.4		336,400	A. C. S. R.			25 min.	30		8	500 to 600				7 sus
	1	39.2		556,500	Al			25 min.	30		8	500 to 600				Pin
	1	25.2		556,500	Al			25 min.	30		8	500 to 600				Tande
	2	82.4		211,600	Cu			25 min.	30		8	500 to 600				7 sus
	2	2.6		214,000	Al			25 min.	30		8	500 to 600				Pin
	1	4.1		214,000	Al			25 min.	30		8	500 to 600				Tande
	1	8.3		133,079	Cu			25 min.	30		8	500 to 600				Tande
	1	14.9		66,373	Cu			25 min.	30		8	500 to 600				Pin
	1	8.6		41,742	Cu			25 min.	30		8	500 to 600				Pin
	1	2.7	¼-inch		S. M. D. G. Steel			25 min.	30		8	500 to 600				Pin
	1	10.4		214,000	Al			25 min.	30		8	500 to 600				5 sus
	1	14.5		41,742	Cu			25 min.	30		8	500 to 600				Pin
	1	12.3		214,000	Al			25 min.	30		8	500 to 600				5 sus
	1	9.0		214,000	Al			25 min.	30		8	500 to 600				5 sus
	2	18.6		400,000	Cu			25 min.	30		8	500 to 600				5 sus
	1	3.5		41,742	Cu			25 min.	30		8	500 to 600				Pin
	1	33.5		66,373	Cu			25 min.	30		8	500 to 600				Pin
	1	24.9		1/0	Cu		144	22 min.		35 min.	10 min.	600	1,700		1,100	
	1	13.2		1/0	Cu		132	22 min.		35 min.	10 min.	600	1,625		1,100	
	1	10.9		1/0	Cu		144	22 min.		35 min.	10 min.	600	1,950		1,100	
	1	10.9		1/0	Al		120 Horiz.—96 Vert.	20 min.		35 min.	10 min.	250	800		1,100	
	1	38.3		1/0	Al		120 Horiz.—96 Vert.	20 min.		35 min.	10 min.	250	850		1,100	
	1	28.8		1/0	Cu		126	20 min.		35 min.	10 min.	600	1,200		1,100	
	2	31.9		1/0	Cu		132	22 min.		35 min.	10 min.	600	1,600		1,100	
	1	15.1		1/0	Cu		126	20 min.		35 min.	10 min.	600	1,200		1,100	
	1	44.4		1/0	Cu		126	20 min.		35 min.	10 min.	600	1,800		1,100	
	1	24.1		1/0	Cu		126	20 min.		35 min.	10 min.	600	2,300		1,100	
	1	25.1		1/0	Cu		144	22 min.		35 min.	10 min.	600	1,600		1,100	
	1	94.0		1/0	Al		126	20 min.		35 min.	10 min.	600	1,800		1,100	
	1	70.4		1/0	Cu		120 Horiz.—96 Vert.	20 min.		35 min.	10 min.	250	800		1,100	
	1	25		1/0	Cu			23	30	30		660	750	15		
	1	66		1/0	Cu			25	30	30		600	1,200	13		
	2	17		2/0	Cu			28	30	30		750	750	20		
w1	1			4/0	A. C. S. R.		120									

Class A Loading—½ Ultimate strength

550	7 type B	Ohio Brass	8 type B	Ohio Brass	No	No	Milliken	Steel	Steel	
550	7 type B	Ohio Brass	8 type B	Ohio Brass	On susp. clamps	No	Blaw-Knox	Steel	Steel	
535	7 susp. type	Ohio Brass	8 susp. type	Ohio Brass	No	No	Riter-Conley	Steel	Steel	
1,000	7 susp. type	Locke	8 susp. type	Locke	Yes	No	Riter-Conley	Steel	Steel	
1,000	7 susp. type	Ohio Brass	8 susp. type	Ohio Brass	Yes	No	Riter-Conley	Steel	Steel	
1,000	7 susp. type	Locke	8 susp. type	Locke	Yes	No	Riter-Conley	Steel	Steel	
1,500	Pin	Thomas	5	Ohio Brass	None	None	Own design	Wood and steel	Steel	Steel
1,500	Pin	Thomas	5	Thomas	None	None	Poles	Wood	Steel	Steel
1,000	Pin	Thomas	5	Thomas	None	None	Poles	Wood	Steel	Steel
2,700	7	Thomas	9	Thomas	On strain	None	Riter-Conley	Steel	Steel	
1,650	7	Ohio Brass	9	Ohio Brass	On strain	None	Riter-Conley	Wood and steel	Steel	
1,000	Pin	Thomas	5	Ohio Brass	None	None	Poles	Wood	Steel	Steel
1,650	7	Ohio Brass	9	Ohio Brass	On strain	None	Riter-Conley	Steel	Steel	
	1 pin	Locke	None		None	None		Steel	Steel	Steel
	1 pin	Locke, Thomas, Ohio Brass	None		None	None		Steel	Steel	Steel
	1 pin	Ohio Brass			None	None		Wood	Wood	Steel
	1 pin	Locke, Thomas	None		None	None		Steel, wood	Steel, wood	Steel
	1 pin	Thomas	None		None	None		Wood	Wood	Steel
	4	Locke		Locke	None	None	Blaw-Knox, Lackawanna			
	4	Thomas, Hewlett	5 units—strain	Thomas Hewlett	None	None		Steel	Steel	Steel
	1 pin	Locke	5 units—strain	Locke	None	None		Wood	Wood, steel	Steel
	4	Locke	5 units	Locke	None	None	Lackawanna	Steel	Steel	Steel
	4	Locke			None	None	Lackawanna	Steel	Steel	Steel
	1 pin	Ohio Brass	None		None	None		Wood	Wood	Steel
					None	None				Steel
	1 pin	Locke						Wood	Wood	Steel
	1 pin	Locke						Wood	Wood	Steel
	1 pin	Locke					Blaw-Knox	Steel	Steel	Steel
	1 pin	Ohio Brass						Wood	Wood	Steel
	1 pin	Locke						Wood	Wood	Steel
	1 pin	Locke						Wood	Wood	Steel
3,000	4 and 5	Jeffery-Dewitt, Locke	5 and 6	Jeffrey-Dewitt, Locke	Yes	No	Riter-Conley	Steel	Steel	
1,500	Pin	Locke	6	Locke	Yes	No		Wood	Steel	Steel
1,000	6	Ohio Ins. Co.	7	Ohio Ins. Co.	Yes	None	Amer. Bridge	Steel	Steel	
1,200	9	Ohio Ins. Co.	10	Ohio Ins. Co.	None	None	Riter-Conley	Steel	Steel	
1,200	9	Lapp	10	Lapp	Yes	None	Amer. Bridge	Steel	Steel	
1,080	8	Ohio Ins. Co.	9	Ohio Ins. Co.	None	None		Wood	Wood	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	None		American Bridge Co.	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	None		American Bridge Co.	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		Amer. Br. and Riter-Conley	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		Amer. Br. and Riter-Conley	Steel	Steel	
	6 strain	Lapp—No. 2,094	7 strain	Lapp No. 2,094	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Lapp—No. 2,094	7 strain	Lapp No. 2,094	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Lapp—No. 2,300	7 strain	Lapp No. 2,300	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Lapp—No. 2,300	7 strain	Lapp No. 2,300	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Lapp—No. 2,300	7 strain	Lapp No. 2,300	None		American Bridge Co.	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Lapp—No. 2,300	7 strain	Lapp No. 2,300	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		Amer. Br. and Riter-Conley	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		Amer. Br. and Riter-Conley	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		American Bridge Co.	Steel	Steel	
	6 strain	Ohio Brass—No. 12,464	7 strain	Ohio Brass No. 12,464	Yes		American Bridge Co.	Steel	Steel	
1,070	8	Ohio Brass	9	Ohio Brass	Yes	No	Designed by R. D. Coombs	Steel	Steel	
	5	Locke—No. 2,335 A	6	Locke No. 2,335A	Bottom only	None	Riter-Conley	Steel	Steel	None
5,000	8	Locke—No. 5,800	9	Locke No. 5,800	Bottom only	None	Archbold Brady	Steel	Steel	None
5,000	8	Jeffery-Dewitt—No. A, 257	9	Jeffrey-Dewitt No. A-257	Bottom only	None	Riter-Conley	Steel	Steel	None
1,100	1 pin	Thomas, Locke	4 link	Thomas Hewlett	Yes	None	Archbold Brady	Wood and steel	Wood and steel	Wood and
2,200	1 pin	Thomas, Westinghouse	4 link	Thomas Hewlett	None	None	Archbold Brady	Steel	Steel	Steel
2,200	1 pin	Thomas, Westinghouse	4 link	Thomas Hewlett	None	None	Archbold Brady	Steel	Steel	Steel
3,000	Link	Thomas, Hewlett	6 link	Thomas	Yes	None	Archbold Brady	Steel	Steel	
1,100	Pin	Thomas	6 link	Thomas	Yes	None	Archbold Brady	Wood and steel	Wood and steel	Wood and
6,500	4	Jeffery-Dewitt	5	Jeffrey-Dewitt	None	None	Archbold Brady	Steel	Steel	
3,500	7	Jeffery-Dewitt	8	Jeffrey-Dewitt	None	None	Lackawanna Bridge Co.	Steel	Steel	
4,000	7	Jeffery-Dewitt	8	Jeffrey-Dewitt	None	None	Archbold Brady — Lackawanna — Bancroft-Jones	Steel	Steel	
1,760	8	Locke—No. 5,800	9	Locke No. 5,800	Yes	None	Archbold Brady	Steel	Steel	
1,500	Pin	Ohio Brass—No. 12,552	7	Ohio Brass No. 25,620				Wood	Wood	Steel
2,000		Locke—No. 5,800	7	Locke No. 5,800	Yes	None	Archbold Brady	Steel	Steel	
400	Pin	Ohio Brass—No. 10,577	7	Ohio Brass No. 25,620				Steel	Steel	Steel
2,000	Pin	Ohio Brass—No. 10,577	7	Ohio Brass No. 25,620			Milliken Aermotor	Steel	Steel	Steel
1,760	8	Locke—No. 5,800	9	Locke No. 5,800	Yes	None	Riter-Conley	Steel	Steel	
,500	Pin	Ohio Brass, No. 12,552	7	Ohio Brass No. 25,620				Wood	Wood	Steel
,000	6	Locke, No. 5,800	7	Locke No. 5,800	Yes	None	Archbold Brady	Steel	Steel	
250	Pin	Ohio Brass, No. 12,552	7	Ohio Brass No. 25,620				Wood	Wood	Steel
580	6	Locke, No. 5,800	7	Locke No. 5,800	Yes	None		Wood	Wood	
,760	8	Locke, No. 5,800	9	Locke No. 5,800	Yes	None	Riter-Conley	Steel	Steel	
,490	8	Locke, No. 5,800	9	Locke No. 5,800	Yes	None		Wood	Steel	
,100+	9 or 10 disc	Jeffrey-Dewitt or Ohio Brass	10 or 11 double	Jeffrey-Dewitt or O. Br	Yes	None	Blaw-Knox	Steel	Steel	None
,100+	9 or 10 disc	Jeffrey-Dewitt or Ohio Brass	10 or 11 double	Jeffrey-Dewitt or O. Br	Yes	None	Blaw-Knox	Steel	Steel	None
,100+	10 disc	Ohio Brass	11 double	Ohio Brass	Yes	None	Blaw-Knox	Steel	Steel	None
,100+	9 disc	Jeffrey-Dewitt	10 double	Jeffrey-Dewitt	Yes	None	Blaw-Knox	Steel	Steel	None
,100+	9 disc	Jeffrey-Dewitt	10 double	Jeffrey-Dewitt	Yes	None	Blaw-Knox	Steel	Steel	None
,100+	9 disc	Jeffrey-Dewitt	10 double	Jeffrey-Dewitt	Yes	None	Blaw-Knox	Steel	Steel	None
	5 sus	Locke	6 sus	Locke	Yes	None	Blaw-Knox	Steel	Steel	None
	5 sus	Locke	6 sus	Locke	Yes	None	Blaw-Knox	Steel	Steel	None
,100+	4	Jeffrey-Dewitt	5 double	Jeffrey-Dewitt	None	None		Wood	Wood	None
,100+	4 or 5	Jeffrey-Dewitt or Locke	5 or 6 double	Jeffrey-Dewitt or Locke	None	None		Wood	Wood	None
,100+	4 or 5	Jeffrey-Dewitt or Locke	5 or 6 double	Jeffrey-Dewitt or Locke	None	None		Wood	Wood	None
,100+	5	Ohio Brass	6 double	Ohio Brass	None	None		Wood	Wood	None
,100+	5	Ohio Brass	6 double	Ohio Brass	Yes	None	Blaw-Knox	Wood, 3 steel	Wood, steel	Steel
,100+	5	Ohio Brass	6 double	Ohio Brass	Yes	None	Pgh. & Des Moines Steel Wks	173 wood, 16 steel	Wood, steel	Steel
2,000	1 pin	Westinghouse	4 sus	Jeffrey-Dewitt	None	None	None	Wood	Wood, steel	Steel
1,500	1 pin	Westinghouse, Thomas	4 sus	Westinghouse	None	None	Bates	Wood	Wood	Steel
	7 sus		9 sus		No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	5 sus				No	No		Steel		
	5 sus				No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	Pin				No	No		Steel		
	Pin				No	No		Wood		
	7 sus		9 sus		No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	7 sus		9 sus		No	No		Steel		
	Pin				No	No		Wood		
	Tandem pin				No	No		Wood		
	7 sus		9 sus		No	No		Steel		
	Pin				No	No		Wood		
	Tandem pin				No	No		Wood		
	Tandem pin				No	No		Wood		
	Pin				No	No		Wood		
	Pin				No	No		Wood		
	Pin				No	No		Wood		
	5 sus				No	No		Wood		
	Pin				No	No		Wood		
	5 sus				No	No		Steel		
	5 sus				No	No		Steel		
	5 sus				No	No		Steel		
	Pin				No	No		Wood		
	Pin				No	No		Wood		
1,100	7	Ohio Brass	8	Ohio Brass	Yes	None	American Bridge Co.	Steel	Steel	
1,100	7	Ohio Brass	8	Ohio Brass	Yes	None	American Bridge Co.	Steel	Steel	
1,100	7	Ohio Brass	8	Ohio Brass	None	None	American Bridge Co.	Steel	Steel	
1,100								Wood	Wood	
1,100								Wood	Wood	
1,100	5	Jeffrey-Dewitt	8	Ohio Brass	None	None		Wood	Wood	
1,100	7	Jeffrey-Dewitt, Thomas	8	Locke Ohio Brass	None	None	American Bridge Co.	Steel	Steel	
1,100	7	Jeffrey-Dewitt	8	Ohio Brass	None	None		Wood	Wood	
1,100	7	Locke, Ohio Brass	8	Locke Ohio Brass		None		Wood	Steel	
1,100	7	Jeffrey-Dewitt, Thomas	8	Onio Brass	Yes	None		Wood	Steel	
1,100	5	Jeffrey-Dewitt, Ohio Brass	6	Ohio Brass Jeffrey-Dewitt		None	American Bridge Co.	Steel	Steel	
1,100	5	Jeffrey-Dewitt, Thomas	6	Ohio Brass Jeffrey Dewitt		None		Wood	Wood	
1,100						None		Wood	Wood	
	9	Ohio Brass, No. 25,622	9	Ohio Brass No. 25,622	Yes	None	Milliken	Steel	Steel	
	9	Ohio Brass, No. 25,622	9	Ohio Brass No. 25,622	Yes	None	Archbold Brady	Steel	Steel	
	9	Ohio Brass, No. 25,622	9	Ohio Brass No. 25,622	Yes	None	Milliken	Steel	Steel	

											Steel	Every tower
	44		10	None		87		Electro	None	Steel	Every tower
	54		10	None		87	None	Electro	None	Steel	Every tower
	50		8	1	5,000	90	None	None	None	None	
	50		9	None		70	None	None	None	None	
	50						None	None	None	None	
	30		5			75	None	None	None	Iron	1
	30		5			75	None	None	None	Iron	1
	30		5	1	5,000	85	Yes	None	None	Iron	1
	42.5		5			75	None	None	None	None	4
	42.5		5			70	None	None	None	Iron	2
	30		5			80	None	None	None	Iron	1
	42.5		5	2	6,000	85	None	None	None	None	4
	38			None		85	Electro	Electro	No	Steel	Each tower
	28 min			None		85	Electro	Electro		Steel	Each tower
	25			None		85	Bennet		O. F. and electro	Steel	Every 4th pole
	25			None		85			Electro	Steel	Every 4th pole
	25			None		85	Bennet electro		None	Steel	Every 4th pole
				None		85		Bennet surge	O. F	None	
	43			None		85		Bennet surge	O. F	None	
	25			None		85			O. F	None	
	43			None		85		Bennet surge		None	
	43			None		85		Bennet surge		None	
	25			None		85			O. F. and electro	Steel	Every 4th pole
				None							
	27 min			None		85			O. F. and electro	Steel	Every 4th pole
	27 min			None		85			Electro	Steel	Every 4th pole
	27			None		85	None	None	None	Steel	Metal contact on tow
	27			None		85			Bennet Surge	None	
	27			None		85			O. F	Steel	Every 4th pole
	27			None		70			O. F	Steel	Every 4th pole
	51.75		3.8	2	3,000	72	None	G. E. oxide film	None	Steel	Each tower
							None	G. E. oxide film	None	None	None
	46.5		5	None	None			Yes		¾ in. str. steel	Every tower
	68		5	None	None			Yes		None	
	46.5		5	None	None			Yes		None	
	39		5	None	None			Yes		None	
	60 average					82		Electro		¾ in. c.c.	Every tower
	60 average					82		Electro		in. c.c.	Every tower
	60 average					82		Electro		in. c.c.	Every tower
	60 average					82		Electro		in. c.c.	Every tower
	60 average			1	7,500	82		Electro		in. c.c.	Every tower
	60 average			1	7,500	82		Electro		in. c.c.	Every tower
	60 average					82		Electro		in. c.c.	Every tower
	60 average					82		Electro		in. steel	Every tower
	60 average					82		Electro		in. steel	Every tower
	60 average					82		Electro		in. steel	Every tower
	60 average			1	7,500	82		Electro		in. steel	Every tower
	60 average			1	7,500	82		Electro		in. steel	Every tower
	60 average					82		Electro		in. c.c.	Every tower
	60 average					82		Electro		in. steel	Every tower
	60 average					82		Electro		in. c.c.	Every tower
	60 average					82		Electro		in. c.c.	Every tower
	60 average			1	7,500	82		Electro		in. steel	Every tower
	60 average			1	7,500	82		Electro		in. steel	Every tower
	60 average			2	7,500	82		Electro		in. steel	Every tower
	60 average			2	7,500	82		Electro		in. steel	Every tower
	48					96		Electro		Cu	Every tower
	50		10	None		60	Oxide film	Electro		¾ in. steel	
	50		5	1	1,500	80—90	None	Oxide film	None	in. cu. clad	
	50		2	None		60—70	None	Oxide film	None	¾ in. steel	
and steel	36		10			80		Auto valve		7/16 in. steel	Every tower
	36		10	1	5,000	95		Electro		7/16 in. steel	Every tower
	36		10	x5	x25,000	85		Electro		7/16 in. steel	Every tower
	50		10	x5	x25,000	85		O. F		7/16 in. steel	Every tower
and steel	36		10			75		Auto valve		7/16 in. steel	Every tower
	40		3.5	None		90		Oxide film		c.c. steel	Each tower
	38			None		90		Oxide film		c.c. steel	Each tower
	40		5	None		90		Auto valve		c.c. steel	Each tower
	47					90		Oxide film		¾ in. cu.	2 pipes per tower
	29.5					90		Oxide film		None	
	39					90		Oxide film		¾ in. steel	Every tower
	43					90		Oxide film		¾ in. steel	Every tower
	50					90		Oxide film		7/16 in. steel	Every tower
	45					85		Oxide film		¾ in. cu.	2 pipes per tower
	29.5					90		Oxide film		None	
	39					90		Oxide film		¾" gal. 7 str. S.M.	Every tower
	31					70		Oxide film		None	
	22.5					80		Oxide film		¾" 7 str. gal. steel	Each pole
	47					90		Oxide film		¾" 7 str. cu. weld.	Each tower
	38					90		Oxide film		None	
	40 min.—87 max.			1—1	30,000-5,000	90	Yes	Electro	None	Gal. steel	Every tower
	40 min.—87 max.			2	10,000	90	Yes	Oxide film	None	Gal. steel	Every tower
	40 min.—65 max.			1	5,000	90	Yes	Electro	None	C.c. steel	Every tower
	40 min.—82 max.			1	5,000	90	Yes	Electro	None	C.c. steel	Every tower
	40 min.—87.5 max.					90	Yes	Oxide film	None	C.c. steel	Every tower
	40 min.—69 max.			1	5,000	90	Yes	Oxide film	None	C.c. steel	Every tower
	50.25					90	Yes	Electro		None	
	50.25					90	Yes	Electro		None	
	25 min.—53 max.					85		Oxide film	None	None	
	25 min.—53 max.					85		Oxide film	None	None	
	25 min.—58 max.					85		Oxide film	None	None	
	25 min.—53 max.					85	Yes	Electro	None	None	
								Electro	None	Steel str	Every pole
								Electro	None		
			5			70	Oxide film	Oxide film		None	
	37		5	1	1,500	90	Oxide film	Oxide film		7/16 in. gal. steel	254
											E-E
											E-E
											E-E

tower	1	2-wire metallic and carrier current	On wood poles			Yes		73
tower	2	2-wire metallic and carrier current	Between towers			Yes		74
tower	1	Carrier current	Between towers			Yes		75
		Carrier current	Between towers		Yes			76
		Carrier current	Between towers		Yes			77
		Carrier current	Between towers		Yes			78
	One on each pole			Oil	Oil	Auto		79
	One on each pole			Oil	Oil	Auto		80
	One on each pole			Oil	Oil	Auto		81
	No wire			Oil	Oil	Auto		82
	Two wires on each pole			Oil	Oil	Auto		83
	One wire on each pole			Oil	Oil	Auto		84
	No wire			Oil	Oil	Auto		85
ower	1	2-wire metallic and carrier current	Both terminals	Yes	Yes	Yes		86
ower	2	2-wire metallic and carrier current	Both terminals	Yes	Yes	Yes		87
4th pole	1	2-wire metallic	All substations	Yes	Yes	Yes		88
4th pole	1	2-wire metallic	All substations	Yes	Yes	Yes		89
4th pole	1	2-wire metallic and carrier current	Both terminals	Yes				90
		Carrier current	Both terminals	Yes	Yes	Yes		91
		Carrier current	Both terminals	Yes	Yes	Yes		92
		None		Yes	Yes	Yes		93
		Carrier current	Both terminals	Yes	Yes	Yes		94
		Carrier current	Both terminals	Yes				95
4th pole	1	2-wire metallic	All sub-stations	Yes	Yes	Yes		96
				Yes				97
4th pole	1	2-wire metallic	All substations	Yes	Yes	Yes		98
4th pole	1	2-wire metallic	All substations	Yes	Yes	Yes		99
contact on tower	1	2-wire metallic						100
		None		Yes	Yes			101
4th pole	1	2-wire metallic	Both terminals	Yes	Yes	Yes		102
4th pole	1	None			Yes			103
ower	1	Wired telephone	Same towers with trans. line	Yes		Yes		104
	None	None	None	Yes	No	No		105
tower	2	Wired telephone	10.5 ft. under X-arm	Yes	Yes	Yes		106
				Yes	Yes	Yes		107
				Yes	Yes	Yes		108
				Yes	Yes	Yes		109
tower	2					Both		110
tower	2					Both		111
tower	2					Both		112
tower	2					Both		113
tower	2					Both		114
tower	2					Both		115
tower	2					Both		116
tower	2					Both		117
tower	2					Both		118
tower	2					Both		119
tower	2					Both		120
tower	2					Both		121
tower	2					Both		122
tower	2					Both		123
tower	2					Both		124
tower	2					Both		125
tower	2					Both		126
tower	2					Both		127
tower	2					Both		128
tower	2					Both		129
y tower	2	None	None	Non-automatic	Yes			130
	1	Telephone	Under towers			Yes		131
	1	Telephone	Under towers	Yes				132
	1	Telephone	Under towers			Yes		133
y tower	1	Telephone	On towers	Yes				134
y tower	1	Bell line		Yes				135
y tower	1	Bell line		Yes				136
y tower	1	Carrier current	At terminals	Yes				137
y tower	1	Bell line		Yes				138
tower	2	Bell line		Yes				139
tower	2	Bell line		Yes				140
tower	2	Bell line		Yes				141
es per tower	1	Telephone	On towers	Yes				142
		Telephone	On same poles	Yes				143
y tower	1	Telephone	On towers	Yes				144
y tower	1	Telephone	On towers	Yes				145
y tower	1	Telephone	On towers	Yes				146
es per tower	1	Telephone	On towers	Yes				147
		Telephone	On same poles	Yes				148
y tower	1	Telephone	On same towers	Yes				149
		Telephone	On poles	Yes				150
pole	1	None		Yes				151
tower	1	Telephone	On towers	Yes				152
	None	None	None	Yes				153
y tower	2	Telephone	On towers below conductors			Yes		154
y tower	2	Telephone	On towers below conductors			Yes		155
y tower	2	Telephone	On towers below conductors			Yes		156
y tower	2	Telephone	On towers below conductors			Yes		157
y tower	2	Telephone	On towers below conductors			Yes		158
y tower	2	Telephone	On towers below conductors			Yes		159
		Telephone	On towers below conductors	O. S.	O. S.	Yes		160
		Telephone	On towers below conductors	O. S.	O. S.	Yes		161
	None	Telephone	On towers below conductors			Yes		162
	None	Telephone	On towers below conductors			Yes		163
	None	Telephone	On towers below conductors			Yes		164
	None	Telephone	On towers below conductors			Yes		165
y pole	1					Yes		166
	None	Telephone	On towers below conductors			Yes		167
		Bell line		4				168
	1	Bell line		5				169
E-E		2 metallic circuits						170
E-E		2 metallic circuits						171
E-E								172
E-E								173
E-E								174
E-E								175
E-E								176
E-E								177
E-E								178
E-E								179
E-E								180
E-E		2 metallic and carrier current						181
E-E		2 metallic and carrier current						182
E-E		2 metallic and carrier current						183
E-E		2 metallic and carrier current						184
E-E		2 metallic and carrier current						185
E-E		2 metallic and carrier current						186
E-E								187
E-E								188
E-E								189
E-E								190
E-E								191
								192
E-E								193
E-E								194
E-E								195
								196
E-E								197
E-E								198
E-E								199
E-E								200
								201
E-E								202
e	None	Telephone	On tower with conductor	Oil	Oil			203
e	None	Telephone	On tower with conductor	Oil	Oil			204
		Telephone	On tower with conductor	Oil	Oil			205
		Telephone	On tower with conductor	Oil	Oil			206
		Telephone	On tower with conductor	Oil	Oil			207
y pole	1	Telephone	On tower with conductor	Oil	Oil			208
		Telephone	On tower with conductor	Oil	Oil			209
		Telephone	On tower with conductor	Oil	Oil			210
		Telephone	On tower with conductor	Oil	Oil			211
		Telephone	On tower with conductor	Oil	Oil			212
		Telephone	On tower with conductor	Oil	Oil			213
y 5 poles	1	Telephone	On tower with conductor	Oil	Oil			214
y 5 poles	1	Telephone	On tower with conductor	Oil	Oil			215
y tower *B*	7	None	None	None	Yes			216
y tower *B*	7	None	None	None	Yes			217
y tower *B*	7	None	None	None	Yes			218
	1	Telephone	50 ft. off center line of towers	Oil	Oil			219
				Air-break	Oil			220

21 Star		Yes	1,000 ohms	Generating plant	1	2	18.0	400,000	Cu	
					1	3.5		41,742	Cu	

200	Echota Sta.—Echota Jct.		1923	.....	.....		.....	.....	.....	60,000	3	25	Star....
201	Westfield Jct.—Westfield		1909	.....	.....		.....	.....	.....	60,000	3	25	Star....
202	Westfield Jct.—Erie		1909	.....	.....		.....	.....	.....	60,000	3	25	Star....
	South Atlantic States												
	Appalachian Power Co.												
203	Bluefield—Wytheville	*L-L*	1912	.....	.....		.....	.....	.....	88,000	3	60	.....
204	Wytheville—Byllesby	*L-L*	1912	.....	.....		.....	.....	.....	88,000	3	60	.....
205	Bluefield—Switchback	*M-M*	1912	.....	.....		.....	.....	.....	88,000	3	60	.....
206	Bluefield—Switchback		1912	.....	.....		.....	.....	.....	88,000	3	60	.....
207	Bluefield—Linkous Ferry		1912	.....	.....		.....	.....	.....	88,000	3	60	.....
208	Glen Lyn—Switchback		1918	.....	.....		.....	.....	.....	88,000	3	60	.....
209	Switchback—Coalwood	*M-M*	1913	.....	.....		.....	.....	.....	88,000	3	60	.....
210	Switchback—Mullens		1914	.....	.....		.....	.....	.....	88,000	3	60	.....
211	Coalwood—Moss		1922—23	.....	.....		.....	.....	.....	88,000	3	60	.....
212	Coalwood—Coal Creek		1922—23	.....	.....		.....	.....	.....	88,000	3	60	.....
213	Glen Lyn—Pulaski		1922	.....	.....		.....	.....	.....	88,000	3	60	.....
214	Byllesby—Sollville		1922	.....	.....		.....	.....	.....	88,000	3	60	.....
215	Byllesby—Roanoke		1912	.....	.....		.....	.....	.....	88,000	3	60	.....
	Virginia Railway & Power Co.												
216	Richmond—Petersburg	*N-N*	1910—13	116,750	144,250		10,000	15,000	15,000	110,000	3	60	Star....
217	Petersburg—Suffolk		1917—18	116,750	144,250		10,000	15,000	15,000	110,000	3	60	Star....
218	Suffolk—Norfolk		1923	116,750	144,250		10,000	15,000	15,000	110,000	3	60	Star....
	Virginia Western Power Co.												
219	Staunton—Charlottesville		1923—24	20,000	.....		15,000	.....	30,000	110,000	3	60	.....
220	Hinton—Clifton Forge		1916	20,000	.....		.....	.....	.....	44,000	3	60	.....
221	Clifton Forge—Buchanan		1914	20,000	.....		15,000	.....	30,000	44,000	3	60	.....
222	Buchanan—Balcony Falls		1914	20,000	.....		.....	.....	.....	44,000	3	60	.....
223	Balcony Falls—Buena Vista		1914	20,000	.....		.....	.....	.....	44,000	3	60	.....
224	Roncoverte—Clifton Forge		1915	20,000	.....		.....	.....	.....	44,000	3	60	.....
225	Roncoverte—Hinton		1916	20,000	.....		.....	.....	.....	44,000	3	60	.....
	Southern Power Company												
226	Standard 44,000 V. Pole Lines		....	.....	.....		.....	.....	.....	44,000	3	60	Delta D
227	Standard 100,000 V. Tower Line		....	.....	.....		.....	.....	.....	100,000	3	60	Delta St
	Columbus Electric & Power Co.												
228	Goat Rock—Newman		1912	35,000	.....		.....	25,000	.....	110,000	3	60	..... Delta St
	Georgia—Alabama Power Co.												
229	Blewitts—Georgetown		1918—20—21	3,625	.....		1,500	3,000	.....	44,000	3	60	Delta St
230	Cordele—Americus		1923	11,650	21,150		.....	2,000	.....	44,000	3	60	Delta St
231	Americus—Albany		1923	11,650	21,150		.....	3,500	.....	44,000	3	60	Delta St
232	Albany—Pelham		1922	11,650	21,150		.....	2,000	.....	44,000	3	60	Delta St
233	Albany—Valdosta		1924	11,650	21,150		.....	3,500	.....	44,000	3	60	Delta St
234	Webb—Enterprise		1922	3,625	.....		500	1,000	.....	44,000	3	60	Delta St
	Georgia Railway & Power Co.												
235	Boulevard—Tallulah		....	110,000	185,000		30,000	40,000	Yes	110,000	3	60	Yes....
236	Boulevard—Lindale		....	110,000	185,000		20,000	25,000	Yes	110,000	3	60	.....
237	Boulevard—Newman		....	110,000	185,000		20,000	25,000	Yes	110,000	3	60	.....
238	Tallulah—Toccoa		....	110,000	185,000		30,000	40,000	Yes	110,000	3	60	.....
239	Toccoa—Winder		....	110,000	185,000		30,000	40,000		110,000	3	60	.....
240	Winder—Marietta		....	110,000	185,000		30,000	40,000		110,000	3	60	.....
241	Lindale—Tennessee		....	110,000	185,000		30,000	40,000		110,000	3	60	.....
242	Lindale—Alabama		....	110,000	185,000		20,000	30,000		110,000	3	60	.....
243	Lindale—Tenn		....	110,000	185,000		5,000	8,000		66,000	3	60	.....
	Central Georgia Power Co.												
244	Lloyd Shoals—Griffin		....	*E*21,000	*E*52,000		.....	.....	.....	66,000	3	60	
245	Griffin—Atlanta		....	*E*21,000	*E*52,000		.....	.....	.....	66,000	3	60	
246	Bibb—Macon		....	*E*21,000	*E*52,000		.....	.....	.....	66,000	3	60	
247	Forsyth—Thomaston		....	*E*21,000	*E*52,000		.....	.....	.....	66,000	3	60	
248	Lloyd—Monticello		....	*E*21,000	*E*52,000		.....	.....	.....	66,000	3	60	
	Florida Power Company												
249	Inglis—Dunnellon		....	5,000	5,500		5,000	5,500	5,500	60,000	3	60	.....
250	Dunnellon—Floral City		....	.....	.....		3,000	3,000	3,000	60,000	3	60	.....
251	Dunnellon—Ocala		....	.....	.....		2,500	2,500	2,500	60,000	3	60	.....
252	Floral City—Zephyrhills		....	.....	.....		2,200	2,200	2,200	60,000	3	60	.....
253	Croom—Bushnell		....	.....	.....		2,000	2,000	2,000	60,000	3	60	.....
	Carolina Pwr. & Lt. Co. and Yadkin River Pwr. Co.												
254	Badin—Sanford		1922	25,000	.....		.....	.....	.....	100,000	3	60	Delta St
255	Laurinburg—Duke		1923	.....	.....		.....	.....	.....	100,000	3	60	.....
256	Method—Buckhorn		1909	2,900	.....	.....	.....	.....	.....	60,000	3	60	Delta St
257	Method—Franklinton		1923	.....	.....		.....	.....	.....	100,000—60,000	3	60	.....
258	Raleigh—Method		1920	3,600	.....		.....	.....	.....	60,000	3	60	Delta De
259	Biscoe—Ashboro		1924	.....	.....		4700	.....	.....	60,000	3	60	.....
260	Ashboro—Franklinville		1924	.....	.....		4700	.....	.....	60,000	3	60	.....
261	Buckhorn—Fayetteville		1909	.....	.....		.....	.....	.....	60,000	3	60	.....
262	Buckhorn—Fayetteville		1901	.....	.....		.....	.....	.....	60,000	3	60	.....
263	Fayetteville—Hope Mills		1913	.....	.....		.....	.....	.....	60,000	3	60	.....
264	Hope Mills—St. Paul		1923	.....	.....		.....	.....	.....	60,000	3	60	.....
265	Fayetteville—Mt. Olive		1924	.....	.....		.....	.....	.....	60,000	3	60	.....
266	Method—Goldsboro		1912	1,200	.....		.....	.....	.....	60,000	3	60	.....
267	Wendell—Zebulon		1924	.....	.....		.....	.....	.....	60,000	3	60	Delta De
268	Franklinton—Henderson		1911	.....	.....		.....	.....	.....	60,000	3	60	.....
269	Henderson—Oxford		1912	.....	.....		.....	.....	.....	60,000	3	60	.....
270	Oxford—Roxboro		1914	.....	.....		.....	.....	.....	60,000	3	60	.....
271	Camden Tap		1922	.....	.....		.....	.....	.....	60,000	3	60	.....
272	Laurinburg—Wateree		1918	14,000	.....		.....	.....	.....	100,000	3	60	.....
273	Laurinburg—Hamlet		1912	.....	.....		.....	.....	.....	100,000	3	60	.....
274	Blewett-Durham		1911	67,500	.....		.....	.....	.....	100,000	3	60	.....
275	Blewett-Hamlet		1912	.....	.....		.....	.....	.....	100,000	3	60	Delta Sta
	East North Central States												
	Peninsular Power Co.												
276	Iron River—Florence		1912	15,000	25,000		8,000	25,000	12,000	66,000	3	60	
277	Pine River—Florence		1921	4,000	6,000		2,000	6,000	3,000	66,000	3	60	
278	Florence—Twin Falls		1912	6,250	10,000		3,000	9,000	4,500	66,000	3	60	
279	Stager—Alpha		1914	.....	.....		1,000	2,000	4,000	66,000	3	60	
280	Alpha—Crystal Falls		1921	.....	.....		1,000	2,000	4,000	66,000	3	60	
	Milwaukee Elec. Ry. & Lt. Co.												
281	Watertown—Milwaukee		1909—14	.....	.....		.....	.....	.....	66,000	3	25	None....
282	Milwaukee—Plymouth		1923	.....	.....		.....	.....	.....	132,000	3	60	Delta Sta
283	Milwaukee—Whitewater		1924	.....	.....		.....	.....	.....	132,000	3	60	Delta Sta
284	Milwaukee—Racine		1924	.....	.....		.....	.....	.....	132,000	3	60	Delta Sta
	Northern States Power Co.												
285	Stillwater—Wissota		1916	.....	.....		.....	.....	.....	120,000	3	60	Delta....
286	Wissota—Colby		1921—23	.....	.....		.....	.....	.....	66,000	3	60	Delta....
287	Eau Claire—Cochrane		1917	.....	.....		.....	.....	.....	66,000	3	60	Delta....
288	Eau Claire—Neillsville		1915 and prior	.....	.....		.....	.....	.....	66,000	3	60	Delta....
289	Cotton School—Blair		1920—21	.....	.....		.....	.....	.....	66,000	3	60	Delta....
290	Cochrane—Bluff Siding		1917	.....	.....		.....	.....	.....	44,000	3	60	Star.....
291	Eau Claire—Cedar Falls	*P-P*	1915	.....	.....		.....	.....	.....	66,000	3	60	Delta....
292	Cedar Falls—Wabasha		Prior to 1912	.....	.....		.....	.....	.....	66,000	3	60	Delta....
293	Herbert Switch—Hastings		1914	.....	.....		.....	.....	.....	66,000	3	60	Delta....
294	Alma Center—La Crosse		1921—22	.....	.....		.....	.....	.....	66,000	3	60	Delta....
295	Sparta—Viroqua		1922	.....	.....		.....	.....	.....	66,000	3	60	Delta...
296	Nelson—Wabasha		1917	.....	.....		.....	.....	.....	66,000	3	60	Delta....
297	Wissota—Eau Claire		1919 and 1924	.....	.....		.....	.....	.....	66,000	3	60	Delta....
298	Wissota—So. St. Paul		1924	.....	.....		.....	.....	.....	120,000	3	60	Delta....
299	Wissota—Jim Falls		1923	.....	.....		.....	.....	.....	120,000	3	60	Star.....
	Lake Superior District Pwr. Co.												
300	Ashland—Ironwood		....	10,000	15,000		10,000	10,000	10,000	66,000	3	60	
301	Ironwood—Big Falls		....	6,600	10,000		10,000	10,000	10,000	88,000	3	60	
	Consol. Wtr. Pwr. & Paper Co.												
302	Wisconsin Rapids—Stevens Pt.		1920—21	15,400	16,000		3,000	.....	.....	44,000	3	60	Delta Del
303	Wisconsin Rapids—Bison		1912	15,400	16,000		3,000	.....	.....	44,000	3	60	Delta Del
	Wisconsin Public Service Corp.												
304	Green Bay—High Falls		1910	.....	.....		12,000	20,000	20,000	66,000	3	60	Star.....
305	Pound—Marinette		1922	.....	.....		3,500	10,000	10,000	66,000	3	60	Delta....
306	Green Bay—Sturgeon Bay		1920	.....	.....		1,200	5,000	5,000	66,000	3	60	Delta....
	Wisc. River Pwr. Lt. & Ht. Co.												
307	Dane—Fond du Lac		....	.....	.....		8,000	8,000	.....	66,000	3	60	.....
	Southern Wisc. Power Co.												
308	Kilbourn—Watertown		1909	6,000	6,000		10,000	20,000	.....	66,000	3	25	.....
	Wisconsin Power & Light Co.												
309	Fond du Lac—Sheboygan		1921	28,000	.....		6,000	10,000	.....	66,000	3	60	.....
	Wisconsin River Power Co.												
310	Prairie du Sac—Portage		....	10,000	10,000		10,000	20,000	.....	66,000	3	25	.....
311	Prairie du Sac—Janesville		....	20,000	20,000		10,000	20,000	.....	66,000	3	60	.....
	Penna.-Ohio Pwr. & Lt. Co.												
312	Lowellville—Ellwood City		1916—17	60,000	60,000		8,000	18,000	.....	66,000	3	60	
313	Lowellville—Ellwood City		1922—23	60,000	60,000		10,000	23,000	.....	66,000	3	60	
314	Lowellville—Masury		1916—17	60,000	60,000		9,000	30,000	.....	66,000	3	60	
315	Lowellville—Brier Hill		1917—18	60,000	60,000		9,000	28,000	.....	66,000	3	60	
316	Lowellville—Brier Hill		1917—18	60,000	60,000		10,000	28,000	.....	66,000	3	60	
317	Lowellville—Bessemer		1920	60,000	60,000		4,500	23,000	.....	66,000	3	60	
318	Brier Hill—Warren		1922—23	.....	.....		10,000	62,000	.....	66,000	3	60	
319	Boardman—Columbiana		1920	60,000	60,000		4,000	15,000	.....	66,000	3	60	.....
	Ohio Public Service Co.												
320	Melco—Mansfield		1916	20,000	20,000		15,000	20,000	20,000	66,000	3	60	Delta....
321	Mansfield—Ashland		1924	20,000	20,000		20,000	20,000	20,000	66,000	3	60	Delta....
322	Ashland—Melco		1916	20,000	20,000		5,000	5,000	5,000	44,000	3	60	Delta....
323	Ashland—Lorain		1924	50,000	150,000		50,000	50,000	50,000	132,000	3	60	Star.....
324	Warren—Alliance		1923	50,000	50,000		50,000	50,000	50,000	132,000	3	60	Star.....
325	Alliance—Canton		1923	50,000	50,000		50,000	50,000	50,000	132,000	3	60	Star.....
	Detroit Edison Company												
326	Marysville—Bloomfield		1923	327,000	496,000	Per circuit	30,000	.....	.....	120,000	3	60	L. T. Del
327	Bloomfield—Superior		1923	.....	.....		.....	.....	.....	120,000	3	60	.....
328	Superior—Brownstown		1924	.....	.....		.....	.....	.....	120,000	3	60	.....
329	Brownstown—Trenton Channel		1924	.....	.....		.....	.....	.....	120,000	6	00	L. T. Del
330	Brownstown—Navarre		1922	.....	.....		.....	.....	.....	120,000	3	60	.....
331	Navarre—Warren		1924	.....	.....		.....	.....	.....	120,000	3	60	.....
332	Brownstown—Monroe		1924	.....	.....		.....	.....	.....	120,000	3	60	.....
	West North Central States—(See end of tabulation for additional lines in this section)												
	Ozark Power & Water Co.												
333	Forsythe—Joplin		1912—13	9,000	9,000		6,000	8,000	8,000	66,000	3	25	.....

25	Star		Yes	1,000 ohms	Generating plant	2	18.6		400,000	Cu		
25	Star		Yes	1,000 ohms	Generating plant	1	3.5		41,742	Cu		
25	Star		Yes	1,000 ohms	Generating plant	1	33.5		66,373	Cu		
60			Yes		Two points	1	24.9		1/0	Cu		
60			Yes		Two points	1	13.2		1/0	Cu		
60			Yes		Two points	1	10.9		1/0	Cu		
60			Yes		Two points	1	10.9		1/0	Al	120 Horiz.—96 Ve	
60			Yes		Two points	1	38.3		1/0	Al	120 Horiz.—96 Ve	
60			Yes		Two points	1	28.8		1/0	Cu		
60			Yes		Two points	2	31.9		1/0	Cu		
60			Yes		Two points	1	15.1		1/0	Cu		
60			Yes		Two points	1	44.4		1/0	Cu		
60			Yes		Two points	1	24.1		1/0	Cu		
60			Yes		Two points	1	25.1		1/0	Cu		
60			Yes		Two points	1	94.0		1/0	Al		
60			Yes		Two points	1	70.4		1/0	Cu	120 Horiz.—96 Ve	
60	Star	Delta	Yes	None	Richmond	1	25		1/0	Cu		
60	Star	Delta	Yes	None		1	66		1/0	Cu		
60	Star	Delta	Yes	None	Norfolk	2	17		2/0	Cu		
60			Yes	None	Terminals	w1	36		4/0	A. C. S. R		
60			None	None		1	68		1/0	Al		
60			None	None		1	24.5		1/0	A. C. S. R		
60			None	None		1	14.5		1/0	A. C. S. R		
60			None	None		1	9		1/0	A. C. S. R		
60			None	Non		1	43		1/0	Al		
60			None	None		1	25		1/0	Al		
60			None	None								
60	Delta Delta	Delta Delta				1	B577		2/0	Cu.—Al		
60	Delta Star and Star Delta	Delta Delta and Delta										
60		Star and Star Delta	Yes			2	B911		2/0	Cu.—Al		
	Delta Star	Star Delta	Yes		Gen. stat	1	60		2/0	Cu		
60	Delta Star	Star Delta	Yes			1 and 2	50	No. 2		A. C. S. R		
60	Delta Star	Star Delta	Yes			1	31	No. 2		A. C. S. R		
60	Delta Star	Star Delta	Yes			1	37		2/0	A. C. S. R		
60	Delta Star	Star Delta	Yes			1	37	No. 2		A. C. S. R		
60	Delta Star	Star Delta	Yes			1	86		2/0	A. C. S. R		
60	Delta Star	Star Delta	Yes			1	40	No. 2 D		A. C. S. R.-D		
60	Yes		Yes		Plant	2	175.2		4/0	Cu		
60						1	68.8		2/0	Cu		
60						1	42.3		2/0	Cu		
60						1	10.4		4/0	Cu		
60						2	48.6		4/0	Cu		
60						1	46.2		4/0	Cu		
60						1	59.8		4/0	Cu		
60						1	15.5		4/0	Al		
60						1	58.4		1/0	Cu		
60	2	2	Yes			2	F10	No. 1 Cop. Eq. F		Al. F		
60	2	3	Yes			2	68.4	1/0 Cop. Eq		Al		
60	2	2	Yes			2	78.8	No. 2 Cop. Eq		Al		
60	2	2	Yes			1	G14.6	No. 2 Cop. Eq. G		Al. G		
60	2	1	Yes			1	9	No. 2 Cop. Eq		Al		
60		60,000—2,300		Isolated	Delta	1	11		1/0	H. D. Cu		
60				Isolated	Delta	1	24	No. 2		Al		
60				Isolated	Delta	1	24.5	No. 2		A. C. S. R		
60				Isolated	Delta	1	38	No. 4		H. D. Cu		
60				Isolated	Delta	1	10	No. 4		H. D. Cu		
60	Delta Star	Star Star	Yes		Pipe line	2	124		397,500	A. C. S. R	125 Vert	
60		Delta Delta				1	63		3/0	Str. Cu	126 Vert	
60	Delta Star	Delta Delta				1	23	No. 2		Str. Cu	120 Horiz	
60		Delta Delta				1	24—24		250,000—3/0	Str. Cu		
60	Delta Delta	Delta Delta				1	3	No. 2		Str. Cu	120 Horiz	
60		Delta Delta				1	21		3/0	Str. Al	84 Horiz	
60		Star Star				1	12		1/0	Str. Cu	84 Horiz	
60		Delta Delta				1	12	No. 4		Sol. Cu	60 Vert	
60		Delta Delta				1	35	No. 2		Str. Al	60 Vert	
60		Delta Delta				1	8		1/0	Str. Cu	72 Vert	
60		Delta Delta				1	13		1/0	Str. Cu	72 Vert	
60		Delta Delta				1	53		3/0	Str. Cu	72 Vert	
60		Delta Delta				1	48	No. 1		Str. Cu	72 Vert.—84 H	
60	Delta Delta	Delta Delta				1	21	No. 2		Sol. Cu	72 Vert.—84 H	
60		Delta Delta				1	16	No. 1		Str. Cu	72 Vert.—84 H	
60		Delta Delta				1	11	No. 2		Str. Cu	72 Vert.—84 H	
60		Delta Delta				1	25	No. 2		Str. Cu	72 Vert.—84 H	
60		Delta Delta				1	5	No. 1		Str. Cu	126 Horiz	
60		Delta Delta				2	120		1/0	Str. Cu		
60		Delta Delta				1	18	No. 1		Str. Cu	108 Vert	
60		Delta Delta				2	175		1/0	Str. Cu	108 Vert	
60	Delta Star	Delta Delta	Yes			1	13	No. 1		Str. Cu	108 Vert	
60		Delta Delta										
60	2,300			5 Kw	Brule	2	50	No. 0		A. C. S. R	72 Vert.—144 H	
60	2,300			5 Kw	Pine River	2	15	No. 3		Cu	72 Vert.—144 H	
60	2,300			5 Kw	Twin Falls	2	20	No. 0		A. C. S. R	72 Vert.—144 H	
60	2,300	2,300		5 Kw		2	6.5	No. 0		A. C. S. R	72 Vert.—144 H	
60	2,300	2,300 to 11,400		5 Kw		2	10.5	No. 2		Cu	72 Vert.—144 H	
25	None	Star Delta		Yes	At transformers	2	42		1/0	Cu	72—	
60	Delta Star	Star Delta	Yes		At transformers	1	67		3/0	A. C. S. R	144—	
60	Delta Star	Star Delta	Yes		At transformers	1	51		3/0	A. C. S. R	144—	
60	Delta Star	Star Delta	Yes		At transformers	1	22		4/0	Cu	144—	
60	Delta	Delta				1	75.5		2/0	Cu		
60	Delta	Delta				1	57.9	No. 2—No. 0		Cu.—Al		
60	Delta	Delta Star	Yes		Cochrane	1	57.6	No. 2		Cu		
60	Delta	Delta				1	55.4	No. 0		Al		
60	Delta	Delta				1	37.4	No. 0		Al		
60	Star	Star	Yes		Cochrane	1	15.6	No. 2		Cu		
60	Delta	Delta				1	24.2	No. 4		Cu		
60	Delta	Delta Star	Yes		Lake City	1	73.0	No. 2—No. 4		Cu		
60	Delta	Delta				1	22.7	No. 4		Cu		
60	Delta	Delta Star	Yes		La Crosse	1	72.8	No. 0		Al		
60	Delta	Delta				1	34.8	No. 0		Al		
60	Delta	Delta				1	2.7	No. 2		Cu		
60	Delta	Delta				1	13.4		2/0—4/0	Cu		
60	Delta	Delta				1	77.3		4/0	Al		
60	Star	Delta	Yes		Twin Falls	2	19.8		2/0	Cu		
60	2,200 to 66,000	66,000 to 33,000	None	None		1	43		66,370	Cu		
60	2,300 to 88,000	88,000 to 33,000	Yes		Big Falls	1	88		133,220	Al		
60	Delta Delta	Delta Delta	None	None		1	17	No. 2		Cu		
60	Delta Delta	Delta Delta	None	None		1	3.5	No. 2		Cu		
60	Star	Delta		3,300	High Falls	2	60.8	No. 0		H. D. Cu		
60	Delta	Delta				1	20.4	No. 0		M. D. S. Cu		
60	Delta	Delta				1	59.6	No. 2		A. C. S. R		
60		500		1—800	Prairie du Sac	1	84.5	83,694 and 133,079		A. C. S. R		
25		600 Kva				2	67		105,500	Str. Cu		
60		5,000 Kva	None	None		1	44		66,370	Cu		
25				1,900	Prairie du Sac	2	23.7		105,500	Str. Cu		
60		18,000 Kva		1,800	Prairie du Sac	2	69.3		133,079	A. C. S. R		
60	2,200 to 66,000	66,000 to 2,200	None	None		2	20.3	No. 2		Cu		
60	2,200 to 66,000	66,000 to 2,200	None	None		2	20.3		1/0	Cu		
60	2,200 to 66,000	66,000 to 2,200	None	None		1	12	No. 2		Cu		
60	2,200 to 66,000	66,000 to 2,200	None	None		2	17		1/0	Cu		
60	2,200 to 66,000	66,000 to 2,200	None	None		2	17		1/0	Cu		
60	2,200 to 66,000	66,000 to 2,200	None	None		1	4.2	No. 2		Cu		
60	13,200 to 66,000	Tied to 66,000 buss	None	None		1	10		336,400	Al		
60		66,000 to 2,200	None	None		1	11	No. 2		Cu		
60	Delta	Delta	None	None	None	1	11		1/0	Cu		
60	Delta	Delta	None	None	None	1	14		336,400	A. C. S. R		
60	Delta	Delta	None	None	None	1	17	No. 4		Cu		
60	Star	Delta	Yes	None	Lovain	1	44		336,400	A. C. S. R		
60	Star	Delta	Yes		Terminals	1	26		336,400	A. C. S. R		
60	Star	Delta	Yes		Alliance	1	19		336,400	A. C. S. R		
60	L. T. Delta—H. T. Star	H. T. Delta—L. T. Star	Yes	None	Power houses only	2	102.8		3/0	Cu		
60		H. T. Delta—L. T. Star				2	71.0		3/0	Cu		
60						2	51.6		3/0	Cu		
00	L. T. Delta—H. T. Star	H. T. Delta—L. T. Star				2	7.1		250,000	Cu		
60		H. T. Delta—L. T. Star				2	26.4		3/0	Cu		
60		H. T. Delta—L. T. Star				2	8.7		3/0	Cu		
60						2	28.0		3/0	Cu		
25		33,000—6,600—2,300				1	145	2/0 and 1/0		Cu		
60	13,200 to 66,000	66,000 to 33,000—2,300	None	None		1	82		2/0	A. C. S. R		

	25 min.	30		8	500 to 600				5 sus.						N
	25 min.	30		8	500 to 600				Pin						N
	25 min.	30		8	500 to 600				Pin						N
144	22 min.		35 min.	10 min.	600	1,700		1,100	7	Ohio Brass		8	Ohio Brass		Ye
132	22 min.		35 min.	10 min.	600	1,625		1,100	7	Ohio Brass		8	Ohio Brass		Ye
144	22 min.		35 min.	10 min.	600	1,950		1,100	7	Ohio Brass		8	Ohio Brass		Ne
120 Horiz.—96 Vert.	20 min.		35 min.	10 min.	250	800		1,100							
120 Horiz.—96 Vert.	20 min.		35 min.	10 min.	250	850		1,100							
126	20 min.		35 min.	10 min.	600	1,200		1,100	5	Jeffrey-Dewitt		8	Ohio Brass		Ne
132	22 min.		35 min.	10 min.	600	1,600		1,100	7	Jeffrey-Dewitt, Thomas		8	Locke Ohio Brass		Ne
126	20 min.		35 min.	10 min.	600	1,200		1,100	7	Jeffrey-Dewitt		8	Ohio Brass		Ne
126	20 min.		35 min.	10 min.	600	1,800		1,100	7	Locke, Ohio Brass		8	Locke Ohio Brass		
126	20 min.		35 min.	10 min.	600	2,300		1,100	7	Jeffrey-Dewitt, Thomas		8	Onio Brass		Ye
144	22 min.		35 min.	10 min.	600	1,600		1,100	5	Jeffrey-Dewitt, Ohio Brass		6	Ohio Brass Jeffrey-Dewitt		
126	20 min.		35 min.	10 min.	600	1,800		1,100	5	Jeffrey-Dewitt, Thomas		6	Ohio Brass Jeffrey Dewitt		
120 Horiz.—96 Vert.	20 min.		35 min.	10 min.	250	800		1,100							
	23	30	30		660	750	15		9	Ohio Brass, No. 25,622		9	Ohio Brass No. 25,622		Ye
	25	30	30		600	1,200	13		9	Ohio Brass, No. 25,622		9	Ohio Brass No. 25,622		Ye
	28	30	30		750	750	20		9	Ohio Brass, No. 25,622		9	Ohio Brass No. 25,622		Ye
120	20	25	40	50	800	1,300			7 sus.	Jeffrey-Dewitt		2 sus.—8 each	Jeffrey-Dewitt		Ne
52	18	24	30	6	150	900			Pin	Thomas		3 and 4	Jeffrey-Dewitt		Ne
52	18	24	30	6	150	900			Pin	Thomas		3 and 4	Jeffrey-Dewitt		Ne
52	18	24	30	6	150	900			Pin	Thomas		3 and 4	Jeffrey-Dewitt		Ne
52	18	24	30	6	150	900			Pin	Thomas		3 and 4	Jeffrey-Dewitt		Ne
52	18	24	30	6	150	900			Pin	Thomas		3 and 4	Jeffrey-Dewitt		Ne
52	18	24	30	6	150	900			Pin	Thomas		3 and 4	Jeffrey Dewitt		Ne
72	22	25	30	10	150		1.5		Pin						
C	22	25	30	10	500		11.5	1,100	5—8			7—10			Ne
120	42	30	33.5	12	500	1,500	6	1,800	7	Ohio Brass, Locke		8	Ohio Brass, Locke		Ye
48	17 min.	20	31	5	250—500	1,200	5.5	525	1 and 2	West., Thomas, Ohio Brass		4	Ohio Brass No. 25,622		Ne
48	17 min.	20	31		350	400	2.25	700	1 and 2	Thomas, No. 3,055		4	Ohio Brass No. 25,622		Ne
48	17 min.	20	31	3	350	700	2.5	1,450	1 and 2	Thomas, No. 3,055		4	Ohio Brass No. 25,622		Ne
60	17 min.	20	31	5	500	1,250	5.5	525	1	Fara, No. 3,544		4	Ohio Brass No. 25,622		Ne
60	17 min.	20	31	4	350	400	2.5	1,450	1 and 2	Ohio Brass, No. 12,552		4	Ohio Brass No. 25,622		Ne
48	17 min.	20	31	5	250—250	500—500	4.0—5.5	1,200—525	1 and 2	Thomas, Ohio Brass, Fara		5	Westinghouse Ohio Brass		Ne
108	25 min.	30 min.	32 min.	17	550	1,250	6—10	2,500	7 sus.	Ohio Brass		9 sus.	Ohio Brass		Ye
108	25 min.	30 min.	32 min.	17	550	1,250	9—15	1,500	7 sus.	Ohio Brass		9 sus.	Ohio Brass		Ye
108	25 min.	30 min.	32 min.	17	550	1,250	9—15	1,500	7 sus.	Ohio Brass		9 sus.	Ohio Brass		Ye
168	25 min.	30 min.	32 min.	None	550	1,350	6—10	2,500	7 sus.	Ohio Brass		9 sus.	Ohio Brass		Ne
120	25 min.	30 min.	32 min.	None	550	1,350	6—10	2,500	7 sus.	Ohio Brass		9 sus.	Ohio Brass		Ye
168	25 min.	30 min.	32 min.	None	550	1,350	6—10	2,500	7 sus.	Ohio Brass		9 sus.	Ohio Brass		Ne
168	25 min.	30 min.	32 min.	None	550	1,350	6—10	2,500	7 sus.	Ohio Brass		9 sus.	Ohio Brass		Ne
168	25 min.	30 min.	32 min.	5—9	550	1,350	6—10	3,000	7 sus.	Ohio Brass		9 sus.	Ohio Brass		Ne
72	25 min.	30 min.	32 min.	None	175	300	4—7	1,000	4	Ohio Brass		9 sus.	Ohio Brass		Ne
78	25	25	32	7	F550	1,000	F25		1 pin.	Ohio Brass		1 pin.	Ohio Brass		Ne
78	25	25	32	7	500—550	1,600	20—25		4 sus.	Ohio Brass		5 sus.	Ohio Brass		Ne
78	25	25	32	7	500—550	1,000	20—25		1 pin.	Ohio Brass		1 pin.	Ohio Brass		Ne
78	25	25	32	7	G200	200	2		1 pin.	Ohio Brass		1 pin.	Ohio Brass		Ne
78	25	25	32	7	150—200	200	2		1 pin.	Ohio Brass		1 pin.	Ohio Brass		Ne
72	30	35	36	3	660	1,100	12	1,400	4 sus.	Locke, Ohio Brass, No. 25,62	2	5	Ohio Brass No. 25,622		Sc
72	30	35	36	3	660	1,200	7	100	4—5	Ohio Brass, No. 25,622		5—6	Ohio Brass		Ne
72	30	35	36	None	480	500	5	900	Pin	Ohio Brass, No. 12,552		5	Ohio Brass		Ye
72	30	34	36	None	480	500	6	1,100	Pin	Locke, No. 1,066		5	Ohio Brass No. 25,622		Ye
72	30	35	36	3	480	550	6	1,100	Pin	Ohio Brass, No. 12,552		5	Ohio Brass No. 25,622		Ye
125 Vert.	25	27	30		750	2,181			7 sus.	Ohio Brass, 25,620		9 sus.	Ohio Brass, 25,620		
126 Vert.	25	27	30		630				7 sus.	Locke, 8,400		9 sus.	Locke, 8,400		
120 Horiz.	25	25	30		700	1,250			4 sus.	Hewlett		5 sus.	Hewlett		
120 Horiz.	25	25	30		595	1,088			7 sus—4 sus.	Locke, 8,400, Hewlett		9 sus—5 sus.	Locke, 8,400—Hewlett		
120 Horiz.	25	25	30		266—630	900			4 sus.	Hewlett		5 sus.	Hewlett		
84 Horiz.	25	25	30	7	300	625			4 sus.	Locke, 8,400		5 sus.	Locke, 8,400		
84 Horiz.	25	25	30	7					4 sus.	Locke, 8,400		5 sus.	Locke, 8,400		
60 Vert.	25	25	30	5	170				Iron pin	Thomas					
60 Vert.	25	25	30	5	122				Iron pin	Thomas					
72 Vert.	25	25	30						4 sus.	Ohio Brass, 25,620		5 sus.	Ohio Brass 25,620		
72 Vert.	25	25	30		300				4 sus.	Locke, 8,400		5 sus.	Locke, 8,400		
72 Vert.	25	25	30						4 sus.	Locke, 8,400		5 sus.	Locke, 8,400		
72 Vert.—84 Horiz.	25	25	30	9	362	775	5.5	700	4 sus.	Thomas, 1,113		5 sus.	Hewlett		
72 Vert.—84 Horiz.	25	25	30	9	300	615	4.5	510	4 sus.	Ohio Brass, 25,620		5 sus.	Ohio Brass, 25,620		
72 Vert.—84 Horiz.	25	25	30	9	360		5.5	700	4 sus.	Hewlett		5 sus.	Hewlett		
72 Vert.—84 Horiz.	25	25	30	9	338		3.5	850	4 sus.	Hewlett, Locke		5 sus.	Hewlett		
72 Vert.—84 Horiz.	25	25	30	9	320	800			4 sus.	Ohio Brass, Sanitary		5 sus.	Ohio Brass Sanitary		
126 Horiz.	25	27	30		365				7 sus.	Ohio Brass, 25,620		8 sus.	Ohio Brass, 25,620		
	25	27	30	11	597	1,749			7 sus.	Hewlett		8 sus.	Hewlett		
108 Vert.	27	27	30		674	1,100			7 sus.	Hewlett		8 sus.	Hewlett		F
108 Vert.	27	27	30		680	1,455	14.5	1,280	7 sus.	Thomas, 1,113		8 sus.	Hewlett		F
108 Vert.	27	27	30		656	1,162			7 sus.	Hewlett		8 sus.	Hewlett		F
72 Vert.—144 Horiz.	20	25	30	8	540	800	16		9	Locke, Jeffrey-Dewitt		11	Locke, Jeffrey-Dewitt		Ye
72 Vert.—144 Horiz.	20	25	30	8	500	650	17		9	Locke, Jeffrey-Dewitt		11	Locke, Jeffrey-Dewitt		Ye
72 Vert.—144 Horiz.	20	25	30	8	540	925	16		9	Locke, Jeffrey-Dewitt		11	Locke, Jeffrey-Dewitt		Ye
72 Vert.—144 Horiz.	20	25	30	8	525	650	16		5	Ohio Brass		6	Ohio Brass		Ye
72 Vert.—144 Horiz.	20	25	30	8	500	650	17		5	Ohio Brass		6	Ohio Brass		Ye
72—144	25	32	40	20	550	639	17.5		4 sus.	Ohio Brass		5 sus.	Ohio Brass		Ne
144—288	25	30	36	12	650	665	18	687	10 sus.	Ohio Brass		12 sus.	Ohio Brass		Ne
144—288	25	30	36	12	650	1,065	18	687	10 sus.	Ohio Brass		12 sus.	Ohio Brass		Ne
144—288	25	30	36	12	650	650	20	1,678	10 sus.	Ohio Brass		12 sus.	Ohio Brass		Ne
126	H	H	H	H		1,800			8 sus.	Ohio Brass		9 sus.	Ohio Brass		Ye
72	H	H	H	H		450			1 pin.	Ohio Brass, Westinghouse		6 sus.	Ohio Brass		Ne
72	H	H	H	H		650			5 sus.	Ohio Brass		6 sus.	Ohio Brass		Ye
66	H	H	H	H		800			1 pin.	Ohio Brass		6 sus.	Ohio Brass		Ne
72	H	H	H	H		300			1 pin.	Ohio Brass		2 pin	Ohio Brass		Ne
72	H	H	H	H		475			5 sus.	Ohio Brass		6 sus.	Ohio Brass		Ne
66	H	H	H	H		800			1 pin.	Lapp		2 pin	Lapp		Ne
66	H	H	H	H		800			1 pin.	Thomas		6 sus.	Ohio Brass		Ne
66	H	H	H	H		350			1 pin.	Ohio Brass		6 sus.	Ohio Brass		Ne
72	H	H	H	H		600			1 pin.	Ohio Brass		6 sus.	Ohio Brass		Ne
72	H	H	H	H		1,200			1 pin.	Ohio Brass		6 sus.	Ohio Brass		Ne
72	H	H	H	H		1,800			5 sus.	Ohio Brass		6 sus.	Ohio Brass		Ye
72	H	H	H	H		300			5 sus.	Ohio Brass		6 sus.	Ohio Brass		Ye
126	H	H	H	H		3,400			8 sus.	Ohio Brass		9 sus.	Ohio Brass		Ye
126	H	H	H	H		450			8 sus.	Ohio Brass		9 sus.	Ohio Brass		Ye
48	30	35	40	8	200	400	2	500	4 sus.	Hewlett, Thomas		5 sus.	Hewlett Thomas		Ne
96	40	40	45	12	600	1,000	15	1,400	6 sus.	Hewlett, Thomas		7 sus.	Hewlett Thomas		Ye
72	50 ft. poles				175										
72	50 ft. poles				175										
72	24.6	25.5	31.5		500	1,300	15	700	5 sus.	Ohio Brass		6 sus.	Ohio Brass		Ye
102	30.6	3.6	31.1		400	400	9.1	700	5 sus.	Ohio Brass		6 sus.	Ohio Brass		
72	39.1	39.1	39.1		200	320	1.5	500	1 pin.	Ohio Brass		6 sus.	Ohio Brass		
72	30	30	30	12	260	500	2.5	750	5 sus.	Thomas, Westinghouse		6 sus.	Thomas, Westinghouse		Ne
72	30	30	30	12	525	663	15	750	4 sus.	Ohio Brass, Locke, Thomas		6 sus.	Ohio Brass		Ye
84	28	28	28	10	200	300	24	750	5 sus.	Ohio Brass		6 sus.	Ohio Brass		Ye
72	30	30	35	12	525	663	15	750	4 sus.	Ohio Brass, Locke		6 sus.	Ohio Brass		Ye
72	30	30	30	12	525	1,100	6.5		5 sus.	Westinghouse, Thomas		6 sus.	Westinghouse, Locke		Ye
92	25	40	40	15	450	940	14	1,800	6 sus.	Ohio Brass		7 sus.	Ohio Brass		Ye
92	25	40	40	15	450	940	16	1,800	6 sus.	Ohio Brass		7 sus.	Ohio Brass		Ye
92	25	40	40	15	501	715	17	1,800	6 sus.	Ohio Brass		7 sus.	Ohio Brass		Ye
92	25	40	40	15	472	627	18.5	1,800	6 sus.	Ohio Brass		7 sus.	Onio Brass		Ye
92	25	40	40	15	472	627	18.5	1,800	6 sus.	Ohio Brass		7 sus.	Ohio Brass		Ye
72		31	31	9.5	150	225	12	1,800	Pin	Ohio Brass		Pin	Ohio Brass		Ne
144	29.5	39	45	30	863	1,098	16.5	6,000	10 sus.	Ohio Brass		11 sus.	Ohio Brass		Ne
72		22		9.5	150	225	12	1,800	5 sus.	Ohio Brass		6 sus.	Ohio Brass		Ne
60	25	30	32	7	150	250	3	1,600	6 sus.	Ohio Brass		7 sus.	Ohio Brass		Ye
144	25	30	39		880	1,000	14	3,500	1 pin.	Ohio Brass		5 sus.	Ohio Brass		Ye
48	25	30	32	7	150	250	3	1,200	10 sus.	Ohio Brass		10 sus.	Ohio Brass		Ye
144	25	35	40		880	1,000	14	3,500	10 sus.	Ohio Brass		10 sus.	Ohio Brass		Ye
144	25	35	40		880	1,000	14	3,500	10 sus.	Ohio Brass		10 sus.	Ohio Brass		Ye
144	25	35	40		880	1,000	14	3,500	10 sus.	Ohio Brass		10 sus.	Ohio Brass		Ye
120	25 min.	40 min.	50 min.	10-30 min.	880	1,000	32	1,500	9 sus.	Ohio Brass, No. 25,620		10 sus.	Ohio Brass, No. 25,620		Ye
120									9 sus.	Ohio Brass, No. 25,620		10 sus.	Ohio Brass, No. 25,620		Ye
120									9 sus.	Ohio Brass, No. 25,620		10 sus.	Ohio Brass, No. 25,620		Ye
120									9 sus.	Ohio Brass, No. 25,620		10 sus.	Ohio Brass, No. 25,620		Ye
120									9 sus.	Ohio Brass, No. 25,620		10 sus.	Ohio Brass, No. 25,620		Ye
120									9 sus.	Ohio Brass, No. 25,620		10 sus.	Ohio Brass, No. 25,620		Ye
66	28	26	28	4	150	150	1.5		Pin	Ohio Brass		7	Ohio Brass		Ne

	No.	No.		Steel								
	No.	No.		Steel								
	No.	No.		Wood								
	No.	No.		Wood								
	Yes	None	American Bridge Co.	Steel	Steel		45		6	1	10,000	
	Yes	None	American Bridge Co.	Steel	Steel		47					
	None	None	American Bridge Co.	Steel	Steel		45					
				Wood	Wood		28					
				Wood	Wood		28					
	None	None		Wood	Wood		34					
ass	None	None	American Bridge Co.	Steel	Steel		47					
	None	None		Wood	Wood		34					
ass		None		Wood	Steel		34					
	Yes	None		Wood	Steel		34					
rey-Dewitt		None	American Bridge Co.	Steel	Steel		45					
rey Dewitt		None		Wood	Wood		34					
		None		Wood	Wood		28					
25,622	Yes	None	Milliken	Steel	Steel		38		A		None	
25,622	Yes	None	Archbold Brady	Steel	Steel		38		A		None	
25,622	Yes	None	Milliken	Steel	Steel		38		A	1	500	
	No	No	Blaw-Knox	Steel	Steel		50 min			None	None	
	None	None	Blaw-Knox	Wood and steel	Steel	Steel	30–100			None	None	
	None	None	Blaw-Knox	Wood and steel	Steel	Steel	30–100			None	None	
	None	None	Blaw-Knox	Wood and steel	Steel	Steel	30–100			None	None	
	None	None	Blaw-Knox	Wood and steel	Steel	Steel	30–100			None	None	
	None	None	Blaw-Knox	Wood and steel	Steel	Steel	30–100			None	None	
	None	None	Blaw-Knox	Wood and steel	Steel	Steel	30–100			None	None	
				Wood	Wood	Steel						
	None	None	Riter-Conley Milliken Aermotor				44					
cke	Yes	None	Milliken	Steel	Steel	None	42		10			
25,622	None	None	Blaw-Knox	Wood and steel	Wood and steel		32					
25,622	None	None	Bates	Steel	Steel		31.25					
25,622	None	None	Bates	Steel	Steel		31.25					
25,622	None	None	Blaw-Knox	Steel	Steel		32					
25,622	None	None	Bates	Steel	Steel		31.5					
Ohio Brass	None	None		Wood	Wood and steel		31.25					
	Yes	None	American Bridge Co.	Steel	Steel		45		10			
	Yes	None	American Bridge Co.	Steel	Steel		50		10			
	Yes	None	American Bridge Co.	Steel	Steel		50		10			
	No	None	H frames	Wood	Wood		25		10			
	Yes	None	Milliken	Steel	Steel		50		10			
	No	None	H frames	Wood	Wood		25		10			
	No	None	H frames	Wood	Wood		25		10			
	No	None	H frames	Wood	Wood		25		10			
	No	None	Single pole	Wood	Steel		25		10			
	None	None	Riter-Conley Milliken	Steel	Steel	Steel			5	None	None	
	None	None	Milliken	Steel	Steel	Steel			5	None	None	
	None	None	Riter-Conley	Steel	Steel	Steel			5	None	None	
	None	None		Wood	Wood	Steel			5	None	None	
	None	None		Wood	Wood	Steel			5	None	None	
25,622	Some	None	Aermotor	Steel	Steel		40			None	None	
	None	None	Aermotor	Steel	Steel		40			None	None	
	Yes	None		Wood	Wood	Steel	30			None	None	
25,622	Yes	None		Wood	Wood	Steel	30			None	None	
25,622	Yes	None		Wood	Wood	Steel	30			None	None	
,620		None		Steel tower	Steel		45					
		None		Steel tower	Steel							
Hewlett		None	Milliken	Steel tower	Steel		40					
		None		Steel tower	Steel							
		None	Milliken	Steel pole, steel tower	Steel		55–40					
		None		Wooden H-frame	Wood							
		None		Wood pole	Wood							
		None		Wood pole	Wood	Iron pin	45					
		None		Wood pole	Wood	Iron pin	25					
620		None		Wood pole	Wood							
		None		Wood pole	Wood							
		None		Wood pole	Wood							
		None		Wood pole	Wood		40		8.5			
,620		None		Wood pole	Wood		30					
		None		Wood pole	Wood		40					
		None		Wood pole	Wood		30		5			
nitary		None		Wood pole	Wood		30		5			
,620		None		Wooden H-frame	Wood		30					
		None		Steel tower	Steel							
	Few	None	Milliken	Steel tower	Steel		45					
	Few	None	Milliken	Steel tower	Steel		45		8.7			
	Few	None	Milliken	Steel tower	Steel		45					
Dewitt	Yes	No	Modern Steel Str. Co.	Steel	Steel	Steel	42.3			None		
Dewitt	Yes	No	Aermotor	Steel	Steel	Steel	42.3			None		
Dewitt	Yes	No	Modern Steel Str. Co.	Steel	Steel	Steel	42.3			None		
	Yes	No	Blaw-Knox	Steel	Steel	Steel	42.3			None		
	Yes	No	American Bridge Co.	Steel	Steel	Steel	42.3			None		
	None		Aermotor Blaw-Knox	Steel	Steel		40					
	None		Blaw-Knox	Steel	Steel		45.5					
	None		Blaw-Knox	Steel	Steel		45.5					
	None		Blaw-Knox	Steel	Steel		45.5					
	Yes		Aermotor	Steel	Steel	Steel	38					
	No			Wood	Wood	Steel	27					
	Yes			Wood	Wood	Steel	30					
	No			Wood	Wood	Steel	27					
	No			Wood	Wood	Steel	27					
	No			Wood	Wood	Steel	30					
	No			Wood	Wood	Steel	27					
	No		Aermotor	Steel	Steel	Steel	38					
	No			Wood	Wood	Steel	27					
	No			Wood	Wood	Steel	27					
	No			Wood	Wood	Steel	27					
	Yes			Wood	Wood	Steel	30					
	Yes			Wood	Wood	Steel	27					
	Yes			Wood	Wood	Steel	30					
	Yes		Aermotor	Steel	Steel	Steel	40					
as	None	None	Poles	Wood	Wood		30		5	None	None	
ns	Yes	None	Blaw-Knox Aermotor	Steel	Steel		40		7	None	None	
	Yes		Aermotor	Steel	Steel		39.6		9.2	None	None	
				Wood	Wood		39.75		3.08	None	None	
				Wood	Steel	Steel	39.6		8.93	None	None	
nghouse	None	None		Wood	Wood	Steel	28		3			
	Yes	None	Aermotor	Steel	Steel		40		9	2	750	
	Yes	None		Wood	Wood	Steel	28		9			
	Yes	None	American Bridge Co.	Steel	Steel		40		5			
Locke	Yes	None	Amer. Br. Co. Aermotor	Steel	Steel		35		5			
	Yes	None	Ritter-Conley	Steel	Steel		44		9.7	1	2,000	
	Yes	None	Ritter-Conley	Steel	Steel		44		9.6	1	5,000	
	Yes	None	Ritter-Conley	Steel	Steel		44		9.8	None		
	Yes	None	Ritter-Conley	Steel	Steel		44		9.9	None		
	Yes	None	Ritter-Conley	Steel	Steel		44		9.9	None		
	None	None		Wood	Wood	Steel	45		2.5	None		
	None	None	American Bridge Co.	Steel	Steel		51		10.0	None		
	None	None		Wood	Wood		45		4.5	None		
	Yes	None		Wood	Wood	Steel	30					
	Yes	None		Wood	Wood	Steel	30					
	Yes	None	American Bridge Co.	Steel	Steel		51					
	Yes	None	American Bridge Co.	Steel	Steel		51					
	Yes	None	American Bridge Co.	Steel	Steel		51					
	Yes	None	American Bridge Co.	Steel	Steel		51					
o. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61		6—7	2	3,000	At 30
o. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61		At 30,000 kw. per circuit			Kva.
o. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61					
o. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61					
o. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61					
o. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61					
o. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61					
	None	None		Steel	Steel	Steel	35.5		16½			
							30–36		8.3	None	None	

				200	Echota Sta.—Echota Jct.	1923											60,000
				201	Westfield Jct.—Westfield	1909											E-E
				202	Westfield Jct.—Erie												E-E
																	E-E
	45		6	1	10,000		87		Electro				None				
	47								Electro				None				
	45								Electro								
	28								Electro				Gal. steel				
	28								Electro				Gal. steel				
	34								Electro				Gal. steel				Every pole
	47								Electro								
	34								Electro				None				
	34								Electro				None				
	34								Electro				None				
	45								Electro								
	34								Electro				Gal. steel				Every 5 poles
	28								Electro				Gal. steel				Every 5 poles
	38		*A*		None				Yes		No		No	¼ in. steel			Every tower *B*
	38		*A*		None				Yes		No		No	¼ in. steel			Every tower *B*
	38		*A*	1	500				Yes		No		No	¼ in. steel			Every tower *B*
50 min					None	None			None		None		None	Cu. clad			238
	30–100				None	None					Electro			S. M. steel			4 per mile
	30–100				None	None					Electro			S. M. steel			4 per mile
	30–100				None	None					Electro			S. M. steel			4 per mile
	30–100				None	None					Electro			S. M. steel			4 per mile
	30–100				None	None					Electro			S. M. steel			4 per mile
	30–100				None	None					Electro			S. M. steel			4 per mile
									None		None			S. M. strand			Each pole
	44								None		None			S. M. strand			Each tower
	42		10				85	Electro. oxide film	Electro oxide film					Steel			Each tower
	32						82		*DB* 44— Surge		*D* 44—*B* Surge			½ in. galv			Each support
	31.25								*D* 34—*B* Surge		*D* 34—*B* Surge			None			
	31.25								*D* 34—*B* Surge		*D* 34—44—*B* Surge			None			
	32										*D* 44—*B* Surge						Each tower
	31.5								*D* 34—*B* Surge		*D* 44—*B* Surge			None			
	31.25										*D* 44—*B* Surge			½ in. galv. S. M.			Every 3 poles
	45		10						None		Westinghouse and G. E.			Steel			Each tower
	50		10								Westinghouse and G. E.			Steel			Each tower
	50		10								Westinghouse and G. E.			Steel			Each tower
	25		10								Westinghouse and G. E.			Steel			Each tower
	50		10								Westinghouse and G. E.			None			None
	25		10								Westinghouse and G. E.			None			None
	25		10								Westinghouse and G. E.			None			None
	25		10								Westinghouse and G. E.			None			None
	25		10								Westinghouse and G. E.			None			None
			5	None	None		80		Electro					C.C. steel			Each tower
			5	None	None		80		Electro					C.C. steel			Each tower
			5	None	None		80		Electro					C.C. steel			Each tower
			5	None	None		80		Electro					C.C. steel			Each tower
			5	None	None		80		Electro					C.C. steel			Each tower
	40			None	None		97—98	Electro	Electro		Closed delta			¼ in. steel			Every tower
	40			None	None		97—98	Electro	Electro					¼ in. steel			Every tower
	30			None	None		97—98	None	None					None			None
	30			None	None		97—98	None	None					None			None
	30			None	None		97—98	None	None					None			None
	45						80							⅜ in. steel			Each tower
	40							Al.						⅜ in. steel			Each tower
									Al.					¼ in. steel			Each tower
	55–40								Al.								Each tower
							85		Al.					¼ in. steel			Each pole, each tower
							85							¼ in. steel			Each pole
	45								Al.					¼ in. steel			Each pole
	25								Al.					None			
									Al.								Each pole
														¼ in. steel			Each pole
														¼ in. steel			Each pole
	40		8.5						Al.					¼ in. steel			Each pole
	30													¼ in. steel			Each pole
	40								Al.					¼ in. steel			Each pole
	30		5						Al.					¼ in. steel			Each pole
	30		5											¼ in. steel			Each pole
	30													None			
									Al.					¼ in. steel			Each tower
	45								Al.					¼ in. steel			Each tower
	45		8.7											¼ in. steel			Each tower
	45								Al.					⅜ in. steel			Each tower
	42.3			None			90		Electro Westinghouse		Westinghouse			C.C. steel			Each tower
	42.3			None			90		Electro Westinghouse		Westinghouse			S. M. steel			Each tower
	42.3			None			90		Electro Westinghouse		Westinghouse			C.C. steel			Each tower
	42.3			None			90		Electro Westinghouse		Westinghouse			S. M. steel			Each tower
	42.3			None			90		Electro Westinghouse		Westinghouse			S. M. steel			Each tower
	40										Al. cell			C.C. steel			
	45.5										Oxide film			None			
	45.5										Oxide film			None			
	45.5										Oxide film			None			
	38										Yes			Steel			Static
	27										Yes			Steel			Static every pole
	30										Yes			Steel			Static 4th pole
	27													Steel			Static every pole
	27										Yes			Steel			Static 5th pole
	30										Yes			Steel			Static every pole
	27										Yes			Steel			Static 5th pole
	38										Yes			Steel			Static every pole
	27										Yes			Steel			Static 4th pole
	27										Yes			Steel			Static 5th pole
	27										Yes			Steel			Static 5th pole
	30										Yes			Steel			Static every pole
	27										Yes			Steel			Static 4th pole
	30										Yes			Steel			Static every pole
	40										Yes			Steel			Static every pole
	30		5	None	None		90	Oxide film	Oxide film		Oxide film			Str. steel			Every 5 poles
	40		7	None	None		90	Oxide film	Oxide film		Oxide film			None			None
	39.6		9.2	None	None		90				Electro			S. M. steel			633
	39.75		3.08	None	None		97				Oxide film			None			None
	39.6		8.93	None	None		97				Electro			Str. steel			316
	28		3				80		Oxide film					None			None
	40		9	2	750		80		Electro					¼ in. steel			Towers
	28		9				80		Oxide film					Steel			Every 1,000 ft.
	40		3				80		Electro					¼ in. steel			Pr. du Sac towers
	35		3				80		Electro					None			None
	44		9.7	1	2,000		80	Al. cell	Al. cell					⅜ in. gal. iron			Every 5th tower
	44		9.6	1	5,000		80	Al. cell	Oxide film					⅜ in. gal. iron			Every 5th tower
	44		9.8	None			80	Al. cell	Al. cell					⅜ in. gal. iron			Every 5th tower
	44		9.9	None			80	Al. cell	Al. cell					⅜ in. gal. iron			Every 5th tower
	44		9.9	None			80	Al. cell	Al. cell					⅜ in. gal. iron			Every 5th tower
	45		2.5	None			80	Al. cell	Al. cell					None			
	51		10.0	None			80	Al. cell	Oxide film					None			
	45		4.5	None			80	Oxide film	Oxide film					None			
	30							Electro						Steel			Every 2nd pole
	30							Electro						Steel			Every 2nd pole
	51							Oil film						None			
	51							Oil film						None			
	51							Oil film						None			
	51							Oil film						None			
	61		6—7	2	3,000	At 30,000			Oxide film					None			None
	61		At 30,000 kw. per circuit			Kva. 100% to 90% leading		Oxide film						None			None
	61							Oxide film						None			None
	61							Oxide film						None			None
	61							Oxide film						None			None
	61							Oxide film						None			None
	61													None			None

E-E							198
E-E							199
							200
E-E							201
							202
	None	Telephone	On tower with conductor	Oil	Oil		203
	None	Telephone	On tower with conductor	Oil	Oil		204
		Telephone	On tower with conductor	Oil	Oil		205
		Telephone	On tower with conductor	Oil	Oil		206
		Telephone	On tower with conductor	Oil	Oil		207
le	1	Telephone	On tower with conductor	Oil	Oil		208
		Telephone	On tower with conductor	Oil	Oil		209
		Telephone	On tower with conductor	Oil	Oil		210
		Telephone	On tower with conductor	Oil	Oil		211
		Telephone	On tower with conductor	Oil	Oil		212
		Telephone	On tower with conductor	Oil	Oil		213
poles	1	Telephone	On tower with conductor	Oil	Oil		214
poles	1	Telephone	On tower with conductor	Oil	Oil		215
wer *B*	7	None	None	None	Yes		216
wer *B*	7	None	None	None	Yes		217
wer *B*	7	None	None	None	Yes		218
	1	Telephone	50 ft. off center line of towers	Oil	Oil		219
e	1	Telephone	Same poles	Air break	Oil		220
e	1	Telephone	Same poles	Air break	Oil		221
e	1	Telephone	Same poles	Air break	Oil		222
e	1	Telephone	Same poles	Air break	Oil		223
e	1	Telephone	Same poles	Air break	Oil		224
e	1	Telephone	Same poles	Air break	Oil		225
e	1						226
ver	1						227
ver	1	Double telephone	On towers	Oil	Oil		228
port	1	Metallic	Under conductors	Hand op	Auto		229
			Under conductors	Hand op	Auto		230
		Metallic	Under conductors	Hand and auto	Auto		231
ver	1	Metallic	Under conductors	Hand op	Auto		232
		Metallic	Under conductors	Hand op			233
poles	1	Metallic	Under conductors	Hand and auto	Auto		234
ver	2	Wired and carrier	Stations and sub-stations	O. S.	O. S.	Yes	235
ver	1	Wired and carrier	Stations and sub-stations	O. S.	O. S.	Yes	236
ver	1	Wired	Stations and sub-stations	O. S.	O. S.	Yes	237
ver	None	None		O. S.	O. S.	Yes	238
	None	None		O. S.	O. S.	Yes	239
	None	None		O. S.	O. S.	Yes	240
	None	None		O. S.	O. S.	Yes	241
	None	None		O. S.	O. S.	Yes	242
	None	None		O. S.	O. S.	Yes	243
ver	1	Metallic	Towers			Yes	244
ver	2	Metallic	Towers			Yes	245
ver	1	Metallic	Towers			Yes	246
ver	1	Metallic	Poles			Yes	247
ver	1	Metallic	Poles			Yes	248
ower	1	Telephone				Yes	249
ower	1	Bell leased line		Yes			250
		Bell leased line		Yes			251
		Bell leased line		Yes			252
		Bell leased line		Yes			253
wer	2	Telephone	Separate poles			Yes	254
wer	1	Telephone	Separate poles			Yes	255
wer	1	Telephone	Towers			Yes	256
wer	2	Telephone	Separate poles	Yes			257
le, each tower	1	Telephone	Poles, towers			Yes	258
le	1	Telephone	H-frames int. poles			Yes	259
le	1	Telephone		Yes			260
le	1	Telephone	Poles			Yes	261
		Telephone	Poles			Yes	262
le	1	Telephone	Poles	Yes			263
le	1	Telephone	Poles	Yes			264
le	1	Telephone	Poles			Yes	265
le	1	Telephone	Poles			Yes	266
le	1	Telephone	Poles			Yes	267
le	1	Telephone	Poles			Yes	268
le	1	Telephone	Poles			Yes	269
le	1	Telephone	Poles	Yes			270
		Telephone	One leg H-frame			Yes	271
wer	2	Telephone	Separate pole and towers			Yes	272
wer	1	Toll telephone		Yes			273
wer	1	Toll telephone	Separate			Yes	274
wer	1	Toll telephone		Yes			275
wer	2	Telephone No. 12	On Western Union Poles	None			276
wer	2	C. C. steel	Separate poles	None			277
wer	2	C. C. steel	On Western Union poles	None			278
wer	2	C. C. steel	Separate poles	None			279
wer	2	C. C. steel	Separate poles	None			280
	1	Telephone		Yes	Yes	Yes	281
		Bell telephone			Yes		282
		Bell telephone			Yes		283
		Telephone			Yes		284
	1	Leased telephone		Yes			285
very pole	1			Yes			286
th pole	2	Telephone		Yes			287
very pole	2	Telephone		Yes			288
th pole	1			Yes			289
very pole	2	Telephone		Yes			290
th pole	1	Telephone		Yes			291
very pole	1	Telephone		Yes			292
th pole	1	Telephone		Yes			293
th pole	1	Telephone		Yes			294
th pole	1	Telephone		Yes			295
very pole	2	Telephone		Yes			296
th pole	1	Telephone		Yes			297
very pole	2	Leased telephone		Yes			298
very pole	1	Telephone		Yes			299
poles	1	Telephone and carrier current	Under conductor	Oil	Oil	Oil	300
		Carrier current	Ironwood Big Falls	Oil	Oil	Oil	301
							302
							303
	2	Telephone		Airbreak oil	Disconnect oil	Yes	304
	None			Airbreak oil	Disconnect oil	Yes	305
	1			Disconnect oil	Disconnect oil	Yes	306
	None	Leased telephone		Auto oil	Auto oil	Auto oil	307
	2	Leased telephone		Auto oil	Auto oil		308
,000 ft	1	Telephone	On same poles	Auto oil	Auto oil		309
Sac towers	2	Telephone	Leased space	Auto oil	Auto oil		310
	None	Leased telephone		Auto oil	Auto oil		311
5th tower	1	Bell telephone		G. E. K. O. oil	G. E. H-6 oil		312
5th tower	1	Bell telephone		G. E. K. O. oil	G. E. H-6 oil		313
5th tower	1	Bell telephone		G. E. K. O. oil	G. E. H-6 oil		314
5th tower	1	Bell telephone		G. E. K. O. oil	G. E. H-6 oil		315
5th tower	1	Bell telephone		G. E. K. O. oil	G. E. H-6 oil		316
		Bell telephone		G. E. K. O. oil	G. E.		317
		Bell telephone		G. E. K. O. 39 B	G. E. K. O. 39 B		318
		Bell telephone		Air break	Air break		319
2nd pole	1	Telephone	Pole line			Yes	320
2nd pole	1	Telephone	Pole line			Yes	321
		Leased telephone				Yes	322
		Leased telephone				Yes	323
		Leased telephone				Yes	324
		Leased telephone				Yes	325
	None	Telephone	Wood poles			Yes	326
	None	Telephone	Wood poles			Yes	327
	None	Telephone	Wood poles			Yes	328
	None	Telephone	Wood poles			Yes	329
	None	Telephone	Wood poles			Yes	330
	None	Telephone	Wood poles			Yes	331
	None	Telephone	Wood poles				332
	2	Telephone	On pole	Knife	Oil		333

	Georgia Railway & Power Co.											
235	Boulevard—Tallulah	....	110,000	185,000		30,000	40,000	Yes	110,000	3	60	Yes
236	Boulevard—Lindale	....	110,000	185,000		20,000	25,000	Yes	110,000	3	60	
237	Boulevard—Newman	....	110,000	185,000		20,000	25,000	Yes	110,000	3	60	
238	Tallulah—Toccoa	....	110,000	185,000		30,000	40,000	Yes	110,000	3	60	
239	Toccoa—Winder	....	110,000	185,000		30,000	40,000		110,000	3	60	
240	Winder—Marietta	....	110,000	185,000		30,000	40,000		110,000	3	60	
241	Lindale—Tennessee	....	110,000	185,000		30,000	40,000		110,000	3	60	
242	Lindale—Alabama	....	110,000	185,000		20,000	30,000		110,000	3	60	
243	Lindale—Tenn	....	110,000	185,000		5,000	8,000		66,000	3	60	
	Central Georgia Power Co.											
244	Lloyd Shoals—Griffin	....	*E*21,000	*E*52,000					66,000	3	60	
245	Griffin—Atlanta	....	*E*21,000	*E*52,000					66,000	3	60	
246	Bibb—Macon	....	*E*21,000	*E*52,000					66,000	3	60	
247	Forsyth—Thomaston	....	*E*21,000	*E*52,000					66,000	3	60	
248	Lloyd—Monticello	....	*E*21,000	*E*52,000					66,000	3	60	
	Florida Power Company											
249	Inglis—Dunnellon	....	5,000	5,500		5,000	5,500	5,500	60,000	3	60	
250	Dunnellon—Floral City	....				3,000	3,000	3,000	60,000	3	60	
251	Dunnellon—Ocala	....				2,500	2,500	2,500	60,000	3	60	
252	Floral City—Zephyrhills	....				2,200	2,200	2,200	60,000	3	60	
253	Croom—Bushnell	....				2,000	2,000	2,000	60,000	3	60	
	Carolina Pwr. & Lt. Co. and Yadkin River Pwr. Co.											
254	Badin—Sanford	1922	25,000						100,000	3	60	Delta St
255	Laurinburg—Duke	1923							100,000	3	60	
256	Method—Buckhorn	1909	2,900						60,000	3	60	Delta St
257	Method—Franklinton	1923							100,000—60,000	3	60	
258	Raleigh—Method	1920	3,600						60,000	3	60	Delta D
259	Biscoe—Ashboro	1924				4700			60,000	3	60	
260	Ashboro—Franklinville	1924				4700			60,000	3	60	
261	Buckhorn—Fayetteville	1909							60,000	3	60	
262	Buckhorn—Fayetteville	1901							60,000	3	60	
263	Fayetteville—Hope Mills	1913							60,000	3	60	
264	Hope Mills—St. Paul	1923							60,000	3	60	
265	Fayetteville—Mt. Olive	1924							60,000	3	60	
266	Method—Goldsboro	1912	1,200						60,000	3	60	Delta D
267	Wendell—Zebulon	1924							60,000	3	60	
268	Franklinton—Henderson	1911							60,000	3	60	
269	Henderson—Oxford	1912							60,000	3	60	
270	Oxford—Roxboro	1914							60,000	3	60	
271	Camden Tap	1922							100,000	3	60	
272	Laurinburg—Wateree	1918	14,000						100,000	3	60	
273	Laurinburg—Hamlet	1912							100,000	3	60	
274	Blewett-Durham	1911	67,500						100,000	3	60	Delta St
275	Blewett-Hamlet	1912							100,000	3	60	
	East North Central States											
	Peninsular Power Co.											
276	Iron River—Florence	1912	15,000	25,000		8,000	25,000	12,000	66,000	3	60	
277	Pine River—Florence	1921	4,000	6,000		2,000	6,000	3,000	66,000	3	60	
278	Florence—Twin Falls	1912	6,250	10,000		3,000	9,000	4,500	66,000	3	60	
279	Stager—Alpha	1914				1,000	2,000	4,000	66,000	3	60	
280	Alpha—Crystal Falls	1921				1,000	2,000	4,000	66,000	3	60	
	Milwaukee Elec. Ry. & Lt. Co.											
281	Watertown—Milwaukee	1909—14							66,000	3	25	None
282	Milwaukee—Plymouth	1923							132,000	3	60	Delta St
283	Milwaukee—Whitewater	1924							132,000	3	60	Delta St
284	Milwaukee—Racine	1924							132,000	3	60	Delta St
	Northern States Power Co.											
285	Stillwater—Wissota	1916							120,000	3	60	Delta
286	Wissota—Colby	1921—23							66,000	3	60	Delta
287	Eau Claire—Cochrane	1917							66,000	3	60	Delta
288	Eau Claire—Neillsville	1915 and prior							66,000	3	60	Delta
289	Cotton School—Blair	1920—21							66,000	3	60	Delta
290	Cochrane—Bluff Siding	1917							44,000	3	60	Star
291	Eau Claire—Cedar Falls	*P-P* 1915							66,000	3	60	Delta
292	Cedar Falls—Wabasha	Prior to 1912							66,000	3	60	Delta
293	Herbert Switch—Hastings	1914							66,000	3	60	Delta
294	Alma Center—La Crosse	1921—22							66,000	3	60	Delta
295	Sparta—Viroqua	1922							66,000	3	60	Delta
296	Nelson—Wabasha	1917							66,000	3	60	Delta
297	Wissota—Eau Claire	1919 and 1924							66,000	3	60	Delta
298	Wissota—So. St. Paul	1924							120,000	3	60	Delta
299	Wissota—Jim Falls	1923							120,000	3	60	Star
	Lake Superior District Pwr. Co.											
300	Ashland—Ironwood	....	10,000	15,000		10,000	10,000	10,000	66,000	3	60	
301	Ironwood—Big Falls	....	6,600	10,000		10,000	10,000	10,000	88,000	3	60	
	Consol. Wtr. Pwr. & Paper Co.											
302	Wisconsin Rapids—Stevens Pt.	1920—21	15,400	16,000		3,000			44,000	3	60	Delta De
303	Wisconsin Rapids—Bison	1912	15,400	16,000		3,000			44,000	3	60	Delta De
	Wisconsin Public Service Corp.											
304	Green Bay—High Falls	1910				12,000	20,000	20,000	66,000	3	60	Star
305	Pound—Marinette	1922				3,500	10,000	10,000	66,000	3	60	Delta
306	Green Bay—Sturgeon Bay	1920				1,200	5,000	5,000	66,000	3	60	Delta
	Wisc. River Pwr. Lt. & Ht. Co.											
307	Dane—Fond du Lac	....				8,000	8,000		66,000	3	60	
	Southern Wisc. Power Co.											
308	Kilbourn—Watertown	1909	6,000	6,000		10,000	20,000		66,000	3	25	
	Wisconsin Power & Light Co.											
309	Fond du Lac—Sheboygan	1921	28,000			6,000	10,000		66,000	3	60	
	Wisconsin River Power Co.											
310	Prairie du Sac—Portage	....	10,000	10,000		10,000	20,000		66,000	3	25	
311	Prairie du Sac—Janesville	....	20,000	20,000		10,000	20,000		66,000	3	60	
	Penna.-Ohio Pwr. & Lt. Co.											
312	Lowellville—Ellwood City	1916—17	60,000	60,000		8,000	18,000		66,000	3	60	
313	Lowellville—Ellwood City	1922—23	60,000	60,000		10,000	23,000		66,000	3	60	
314	Lowellville—Masury	1916—17	60,000	60,000		9,000	30,000		66,000	3	60	
315	Lowellville—Brier Hill	1917—18	60,000	60,000		9,000	28,000		66,000	3	60	
316	Lowellville—Brier Hill	1917—18	60,000	60,000		10,000	28,000		66,000	3	60	
317	Lowellville—Bessemer	1920	60,000	60,000		4,500	23,000		66,000	3	60	
318	Brier Hill—Warren	1922—23				10,000	62,000		66,000	3	60	
319	Boardman—Columbiana	1920	60,000	60,000		4,000	15,000		66,000	3	60	
	Ohio Public Service Co.											
320	Melco—Mansfield	1916	20,000	20,000		15,000	20,000	20,000	66,000	3	60	Delta
321	Mansfield—Ashland	1924	20,000	20,000		20,000	20,000	20,000	66,000	3	60	Delta
322	Ashland—Melco	1916	20,000	20,000		5,000	5,000	5,000	44,000	3	60	Delta
323	Ashland—Lorain	1924	50,000	150,000		50,000	50,000	50,000	132,000	3	60	Star
324	Warren—Alliance	1923	50,000	50,000		50,000	50,000	50,000	132,000	3	60	Star
325	Alliance—Canton	1923	50,000	50,000		50,000	50,000	50,000	132,000	3	60	Star
	Detroit Edison Company											
326	Marysville—Bloomfield	1923	327,000	496,000	Per circuit	30,000			120,000	3	60	L. T. Del
327	Bloomfield—Superior	1923							120,000	3	60	
328	Superior—Brownstown	1924							120,000	3	60	
329	Brownstown—Trenton Channel	1924							120,000	6	00	L. T. Del
330	Brownstown—Navarre	1922							120,000	3	60	
331	Navarre—Warren	1924							120,000	3	60	
332	Brownstown—Monroe	1924							120,000	3	60	
	West North Central States—(See end of tabulation for additional lines in this section)											
	Ozark Power & Water Co.											
333	Forsythe—Joplin	1912—13	9,000	9,000		6,000	8,000	8,000	66,000	3	25	
	Kansas City Pwr. & Lt. Co.											
334	Kansas City—Carrollton	1922	72,000			5,600	10,000	10,000	66,000	3	60	
	Des Moines Electric Co.											
335	Des Moines—Prairie City	....	30,000	175,000		3,000			44,000	3	60	Star Delt
336	Prairie City—Newton	....	30,000	175,000		3,000			44,000	3	60	
337	Prairie City—Oskaloosa	....	30,000	175,000		4,000			44,000	3	60	
338	Otley—Knoxville	....	30,000	175,000		2,000			44,000	3	60	
339	Des Moines—Valley Junction	....	30,000	175,000		6,000			44,000	3	60	
	Mississippi River Pwr. Co.											
340	Keokuk—St. Louis	1912—13	135,000			90,000			110,000	3	25	Delta St
341	Meppen—Alton	1912—13				13,000			66,000	3	25	Delta De
	Minnesota Power and Lt. Co.											
342	Winton Sta. to Tower	1924	5,000	10,000					44,000	3	60	Delta St
343	Winton—Virginia	1923	12,500						110,000	3	60	Delta St
344	Fond du Lac—Thomson	1923	15,000	30,000					110,000	3	60	Delta St
345	Thomson—Nashwauk	1923	29,000						110,000	3	60	Delta St
346	Blanchard—Nashwauk	1924	20,000						110,000	3	60	Delta St
347	Thomson—Hibbing	1917	12,300	12,300					66,000	3	60	Delta De
348	Thomson Sta.—62 Ave. W. Sub	1921							66,000	3	60	Delta De

a—60,000 kva. hydro plant at Turners Falls; 36,000 kva. steam plant at Chicopee; 60,000 kva. steam plant at Springfield; 70,000 kva. steam plant at Hartford.

b—70,000 kva. hydro plant at Turners Falls; 100,000 kva. at Chicopee; ultimate at other points unknown (steam).

c—System as operated today is all 66,000 volt. Lines designed for 110,000 Therefore transformers at every gener plant and substation.

d—Neutral grounded solidly at Y of high tension transformer connecti Hampton station.

e—Special wire.

f—Separate pole lines.

60	Yes		Yes		Plant	2	175.2		4/0	Cu			
60						1	68.8		2/0	Cu			
60						1	42.3		2/0	Cu			
60						1	10.4		4/0	Cu			
60						2	48.6		4/0	Cu			
60						1	46.2		4/0	Cu			
60						1	59.8		4/0	Cu			
60						1	15.5		4/0	Al			
60						1	58.4		1/0	Cu			
60		2	2	Yes		2	*F*10	No. 1 Cop. Eq. *F*		Al. *F*			
60		2	3	Yes		2	68.4	1/0 Cop. Eq.		Al			
60		2	2	Yes		2	78.8	No. 2 Cop. Eq.		Al			
60		2	2	Yes		1	*G*14.6	No. 2 Cop. Eq. *G*		Al. *G*			
60		2	1	Yes		1	9	No. 2 Cop. Eq.		Al			
60		60,000—2,300	Isolated	Delta		1	11		1/0	H. D. Cu			
60			Isolated	Delta		1	24	No. 2		Al			
60			Isolated	Delta		1	24.5	No. 2		A. C. S. R			
60			Isolated	Delta		1	38	No. 4		H. D. Cu			
60			Isolated	Delta		1	10	No. 4		H. D. Cu			
60	Delta Star	Star Star	Yes		Pipe line	2	124		397,500	A. C. S. R	125 Vert.		
60		Delta Delta				1	63		3/0	Str. Cu	126 Vert.		
60	Delta Star	Delta Delta				1	23	No. 2		Str. Cu	120 Horiz.		
60		Delta Delta				1	24—24		250,000—3/0	Str. Cu			
60	Delta Delta	Delta Delta				1	3	No. 2		Str. Cu	120 Horiz.		
60		Delta Delta				1	21		3/0	Str. Al	84 Horiz.		
60		Star Star				1	12		1/0	Str. Cu	84 Horiz.		
60		Delta Delta				1	12	No. 4		Sol. Cu	60 Vert.		
60		Delta Delta				1	35	No. 2		Str. Al	60 Vert.		
60		Delta Delta				1	8		1/0	Str. Cu	72 Vert.		
60		Delta Delta				1	13		1/0	Str. Cu	72 Vert.		
60		Delta Delta				1	53		3/0	Str. Cu	72 Vert.		
60	Delta Delta	Delta Delta				1	48	No. 1		Str. Cu	72 Vert.—84 H		
60		Delta Delta				1	21	No. 2		Sol. Cu	72 Vert.—84 H		
60		Delta Delta				1	16	No. 1		Str. Cu	72 Vert.—84 H		
60		Delta Delta				1	11	No. 2		Str. Cu	72 Vert.—84 H		
60		Delta Delta				1	25	No. 2		Str. Cu	72 Vert.—84 H		
60		Delta Delta				1	5	No. 1		Str. Cu	126 Horiz.		
60		Delta Delta				2	120		1/0	Str. Cu			
60		Delta Delta				1	18	No. 1		Str. Cu	108 Vert.		
60	Delta Star	Delta Delta	Yes			2	175		1/0	Str. Cu	108 Vert.		
60		Delta Delta				1	13	No. 1		Str. Cu	108 Vert.		
60		2,300		5 Kw	Brule	2	50	No. 0		A. C. S. R	72 Vert.—144 H		
60		2,300		5 Kw	Pine River	2	15	No. 3		Cu	72 Vert.—144 H		
60		2,300		5 Kw	Twin Falls	2	20	No. 0		A. C. S. R	72 Vert.—144 H		
60		2,300	2,300	5 Kw		2	6.5	No. 0		A. C. S. R	72 Vert.—144 H		
60		2,300	2,300 to 11,400	5 Kw		2	10.5	No. 2		Cu	72 Vert.—144 H		
25	None	Star Delta		Yes	At transformers	2	42		1/0	Cu	72—		
60	Delta Star	Star Delta	Yes		At transformers	1	67		3/0	A. C. S. R	144—		
60	Delta Star	Star Delta	Yes		At transformers	1	51		3/0	A. C. S. R	144—		
60	Delta Star	Star Delta	Yes		At transformers	1	22		4/0	Cu	144—		
60	Delta	Delta				1	75.5		2/0	Cu			
60	Delta	Delta				1	57.9	No. 2—No. 0		Cu.—Al			
60	Delta	Delta Star	Yes		Cochrane	1	57.6	No. 2		Cu			
60	Delta	Delta				1	55.4	No. 0		Al			
60	Delta	Delta				1	37.4	No. 0		Al			
60	Star	Star	Yes		Cochrane	1	15.6	No. 2		Cu			
60	Delta	Delta				1	24.2	No. 4		Cu			
60	Delta	Delta Star	Yes		Lake City	1	73.0	No. 2—No. 4		Cu			
60	Delta	Delta				1	22.7	No. 4		Cu			
60	Delta	Delta Star	Yes		La Crosse	1	72.8	No. 0		Al			
60	Delta	Delta				1	34.8	No. 0		Al			
60	Delta	Delta				1	2.7	No. 2		Cu			
60	Delta	Delta				1	13.4		2/0—4/0	Cu			
60	Delta	Delta				1	77.3		4/0	Al			
60	Star	Delta	Yes		Twin Falls	2	19.8		2/0	Cu			
60	2,200 to 66,000	66,000 to 33,000	None	None		1	43		66,370	Cu			
60	2,300 to 88,000	88,000 to 33,000	Yes		Big Falls	1	88		133,220	Al			
60	Delta Delta	Delta Delta	None	None		1	17	No. 2		Cu			
60	Delta Delta	Delta Delta	None	None		1	3.5	No. 2		Cu			
60	Star	Delta		3,300	High Falls	2	60.8	No. 0		H. D. Cu			
60	Delta	Delta				1	20.4	No. 0		M. D. S. Cu			
60	Delta	Delta				1	59.6	No. 2		A. C. S. R			
60		500		1—800	Prairie du Sac	1	84.5	83,694 and 133,079		A. C. S. R			
25		600 Kva				2	67		105,500	Str. Cu			
60		5,000 Kva	None	None		1	44		66,370	Cu			
25				1,900	Prairie du Sac	2	23.7		105,500	Str. Cu			
60		18,000 Kva		1,800	Prairie du Sac	2	69.3		133,079	A. C. S. R			
60	2,200 to 66,000	66,000 to 2,200	None	None		2	20.3	No. 2		Cu			
60	2,200 to 66,000	66,000 to 2,200	None	None		2	20.3		1/0	Cu			
60	2,200 to 66,000	66,000 to 2,200	None	None		1	12	No. 2		Cu			
60	2,200 to 66,000	66,000 to 2,200	None	None		2	17		1/0	Cu			
60	2,200 to 66,000	66,000 to 2,200	None	None		2	17		1/0	Cu			
60	2,200 to 66,000	66,000 to 2,200	None	None		1	4.2	No. 2		Cu			
60	13,200 to 66,000	Tied to 66,000 buss	None	None		1	10		336,400	Al			
60		66,000 to 2,200	None	None		1	11	No. 2		Cu			
60	Delta	Delta	None	None	None	1	11		1/0	Cu			
60	Delta	Delta	None	None	None	1	14		336,400	A. C. S. R			
60	Delta	Delta	None	None	None	1	17	No. 4		Cu			
60	Star	Delta	Yes	None	Lovain	1	44		336,400	A. C. S. R			
60	Star	Delta	Yes		Terminals	1	26		336,400	A. C. S. R			
60	Star	Delta	Yes		Alliance	1	19		336,400	A. C. S. R			
60	L. T. Delta—H. T. Star	H. T. Delta—L. T. Star	Yes	None	Power houses only	2	102.8		3/0	Cu			
60		H. T. Delta—L. T. Star				2	71.0		3/0	Cu			
60						2	51.6		3/0	Cu			
00	L. T. Delta—H. T. Star	H. T. Delta—L. T. Star				2	7.1		250,000	Cu			
60		H. T. Delta—L. T. Star				2	26.4		3/0	Cu			
60		H. T. Delta—L. T. Star				2	8.7		3/0	Cu			
60						2	28.0		3/0	Cu			
25		33,000—6,600—2,300				1	145	2/0 and 1/0		Cu			
60	13,200 to 66,000	66,000 to 33,000—2,300	None	None		1	82		2/0	A. C. S. R			
60	Star Delta	Delta Delta				1	20	No. 4		Cu	60 Vert.—52 Ho		
60		Delta Delta				1	16		1/0	A. C. S. R	60 Vert.—52 Ho		
60		Delta Delta				1	40		1/0	A. C. S. R	117 Vert.—150 H		
60		Delta Delta				1	12	No. 4		Cu	60 Vert.—59 Ho		
60		Delta Delta				1	9	No. 1		Cu	54 Vert.—52 Ho		
25	Delta Star	Delta Delta	Yes		Station end only	2	143.8		300,000	Cu			
25	Delta Delta	Delta Delta	No		None	1	28.7	No. 2		Cu	Triangle 84, 156,		
60	Delta Star	Delta Star	Yes		Gen. Sta	1	25.8	No. 2		Cu	60 Tri		
60	Delta Star	Delta Star	Yes		Gen. and Sub	1	50.7		4/0	Cu	132 Horiz.		
60	Delta Star	Star Delta	Yes		Gen. and Sub	1	2.2		4/0	Cu	132 Horiz.		
60	Delta Star	Delta Star	Yes		Gen. and Sub	1	65.1		4/0	Cu	132 Horiz.		
60	Delta Star	Delta Star	Yes		Gen. and Sub	1	126.0		4/0	Cu	132 Horiz.		
60	Delta Delta	Delta Delta	No			1	85.0	No. 1		Cu	78 Horiz.—66 V		
60	Delta Delta	Delta Star	No			1	11.8	No. 1		Cu	78 Horiz.—66 V		

or 110,000 volts.
t every generating

olidly at Y point
mer connection at

g—None at present; carrier current ultimate.
h—Per circuit.
i—Installed transformer capacity.
j—Distances are between stations.
k—66,000 volt at present, 110,000 proposed.
l—To company line.

m—45,000 volt at present, future 110,000 volt.
n—Does not include any capacity of Metropolitan Edison Co. system.
p—66 kw. tie with M. E. Co. system.
q—2 plants.
r—May be raised to 110,000 volts.
s—Connection to Adirondack L. & P. Co.

t—Built for 110,000 volts.
u—Rating of lines based on 10% voltage drop, 85% P. F. 60 cycles.
v—½ A. P. & L. Corp. and ½ United Hudson El. Corp.
w—1 now, 1 in future.
x—Lines combined.
y—Does not include river span of 2011

feet on steel towe
z—Constructed
A—Stations at
maintain practica
B—Ground wir
Tower legs consi
tower.
C—Vertical 120

	48	17 min.	20	31	5	250—250	500—500	4.0—5.5	1,200—525	1 and 2	Thomas, Ohio Brass, Fara..		5	Westinghouse Ohio Brass.
	108	25 min.	30 min.	32 min.	17	550	1,250	6—10	2,500	7 sus	Ohio Brass	9 sus		Ohio Brass
	108	25 min.	30 min.	32 min.	17	550	1,250	9—15	1,500	7 sus	Ohio Brass	9 sus		Ohio Brass
	108	25 min.	30 min.	32 min.	17	550	1,250	9—15	1,500	7 sus	Ohio Brass	9 sus		Ohio Brass
	168	25 min.	30 min.	32 min.	None	550	1,350	6—10	2,500	7 sus	Ohio Brass	9 sus		Ohio Brass
	120	25 min.	30 min.	32 min.	None	550	1,350	6—10	2,500	7 sus	Ohio Brass	9 sus		Ohio Brass
	168	25 min.	30 min.	32 min.	None	550	1,350	6—10	2,500	7 sus	Ohio Brass	9 sus		Ohio Brass
	168	25 min.	30 min.	32 min.	None	550	1,350	6—10	2,500	7 sus	Ohio Brass	9 sus		Ohio Brass
	168	25 min.	30 min.	32 min.	5—9	550	1,350	6—10	3,000	7 sus	Ohio Brass	9 sus		Ohio Brass
	72	25 min.	30 min.	32 min.	None	175	300	4—7	1,000	4	Ohio Brass	9 sus		Ohio Brass
	78	25	25	32	7	*F*550	1,000	*F*25		1 pin	Ohio Brass	1 pin		Ohio Brass
	78	25	25	32	7	500—550	1,600	20—25		4 sus	Ohio Brass	5 sus		Ohio Brass
	78	25	25	32	7	500—550	1,000	20—25		1 pin	Ohio Brass	1 pin		Ohio Brass
	78	25	25	32	7	*G*200	200	2		1 pin	Ohio Brass	1 pin		Ohio Brass
	78	25	25	32	7	150—200	200	2		1 pin	Ohio Brass	1 pin		Ohio Brass
	72	30	35	36	3	660	1,100	12	1,400	4 sus	Locke, Ohio Brass, No. 25,62	2	5	Ohio Brass No. 25,622
	72	30	35	36	3	660	1,200	7	100	4—5	Ohio Brass, No. 25,622		5—6	Ohio Brass
	72	30	35	36	None	480	500	5	900	Pin	Ohio Brass, No. 12,552		5	Ohio Brass
	72	30	34	36	None	480	500	6	1,100	Pin	Locke, No. 1,066		5	Ohio Brass No. 25,622
	72	30	35	36	3	480	550	6	1,100	Pin	Ohio Brass, No. 12,552		5	Ohio Brass No. 25,622
125 Vert.		25	27	30		750	2,181			7 sus	Ohio Brass, 25,620	9 sus		Ohio Brass, 25,620
126 Vert.		25	27	30		630				7 sus	Locke, 8,400	9 sus		Locke, 8,400
120 Horiz.		25	25	30		700	1,250			4 sus	Hewlett	5 sus		Hewlett
		25	25	30		595	1,088			7 sus—4 sus	Locke, 8,400, Hewlett	9 sus—5 sus		Locke, 8,400—Hewlett
120 Horiz.		25	25	30		266—630	900			4 sus	Hewlett	5 sus		Hewlett
84 Horiz.		25	25	30	7	300	625			4 sus	Locke, 8,400	5 sus		Locke, 8,400
84 Horiz.		25	25	30	7					4 sus	Locke, 8,400	5 sus		Locke, 8,400
60 Vert.		25	25	30	5	170				Iron pin	Thomas			
60 Vert.		25	25	30	5	122				Iron pin	Thomas			
72 Vert.		25	25	30						4 sus	Ohio Brass, 25,620	5 sus		Ohio Brass 25,620
72 Vert.		25	25	30		300				4 sus	Locke, 8,400	5 sus		Locke, 8,400
72 Vert.		25	25	30						4 sus	Locke, 8,400	5 sus		Locke, 8,400
72 Vert.—84 Horiz.		25	25	30	9	362	775	5.5	700	4 sus	Thomas, 1,113	5 sus		Hewlett
72 Vert.—84 Horiz.		25	25	30	9	300	615	4.5	510	4 sus	Ohio Brass, 25,620	5 sus		Ohio Brass, 25,620
72 Vert.—84 Horiz.		25	25	30	9	360		5.5	700	4 sus	Hewlett	5 sus		Hewlett
72 Vert.—84 Horiz.		25	25	30	9	338		3.5	850	4 sus	Hewlett, Locke	5 sus		Hewlett
72 Vert.—84 Horiz.		25	25	30	9	320	800			4 sus	Ohio Brass, Sanitary	5 sus		Ohio Brass Sanitary
126 Horiz.		25	27	30		365				7 sus	Ohio Brass, 25,620	8 sus		Ohio Brass, 25,620
		25	27	30	11	597	1,749			7 sus	Hewlett	8 sus		Hewlett
108 Vert.		27	27	30		674	1,100			7 sus	Hewlett	8 sus		Hewlett
108 Vert.		27	27	30		680	1,455	14.5	1,280	7 sus	Thomas, 1,113	8 sus		Hewlett
108 Vert.		27	27	30		656	1,162			7 sus	Hewlett	8 sus		Hewlett
72 Vert.—144 Horiz.		20	25	30	8	540	800	16		9	Locke, Jeffrey-Dewitt		11	Locke, Jeffrey-Dewitt
72 Vert.—144 Horiz.		20	25	30	8	500	650	17		9	Locke, Jeffrey-Dewitt		11	Locke, Jeffrey-Dewitt
72 Vert.—144 Horiz.		20	25	30	8	540	925	16		9	Locke, Jeffrey-Dewitt		11	Locke, Jeffrey-Dewitt
72 Vert.—144 Horiz.		20	25	30	8	525	650	16		5	Ohio Brass		6	Ohio Brass
72 Vert.—144 Horiz.		20	25	30	8	500	650	17		5	Ohio Brass		6	Ohio Brass
72—144		25	32	40	20	550	639	17.5		4 sus	Ohio Brass	5 sus		Ohio Brass
144—288		25	30	36	12	650	665	18	687	10 sus	Ohio Brass	12 sus		Ohio Brass
144—288		25	30	36	12	650	1,065	18	687	10 sus	Ohio Brass	12 sus		Ohio Brass
144—288		25	30	36	12	650	650	20	1,678	10 sus	Ohio Brass	12 sus		Ohio Brass
126		*H*	*H*	*H*	*H*		1,800			8 sus	Ohio Brass	9 sus		Ohio Brass
72		*H*	*H*	*H*	*H*		450			1 pin	Ohio Brass, Westinghouse	6 sus		Ohio Brass
72		*H*	*H*	*H*	*H*		650			5 sus	Ohio Brass	6 sus		Ohio Brass
66		*H*	*H*	*H*	*H*		800			1 pin	Ohio Brass	6 sus		Ohio Brass
72		*H*	*H*	*H*	*H*		300			1 pin	Ohio Brass	2 pin		Ohio Brass
72		*H*	*H*	*H*	*H*		475			5 sus	Ohio Brass	6 sus		Ohio Brass
66		*H*	*H*	*H*	*H*		800			1 pin	Lapp	2 pin		Lapp
66		*H*	*H*	*H*	*H*		800			1 pin	Thomas	6 sus		Ohio Brass
66		*H*	*H*	*H*	*H*		350			1 pin	Ohio Brass	6 sus		Ohio Brass
72		*H*	*H*	*H*	*H*		600			1 pin	Ohio Brass	6 sus		Ohio Brass
72		*H*	*H*	*H*	*H*		1,200			1 pin	Ohio Brass	6 sus		Ohio Brass
72		*H*	*H*	*H*	*H*		1,800			5 sus	Ohio Brass	6 sus		Ohio Brass
72		*H*	*H*	*H*	*H*		300			5 sus	Ohio Brass	6 sus		Ohio Brass
126		*H*	*H*	*H*	*H*		3,400			8 sus	Ohio Brass	9 sus		Ohio Brass
126		*H*	*H*	*H*	*H*		450			8 sus	Ohio Brass	9 sus		Ohio Brass
48		30	35	40	8	200	400	2	500	4 sus	Hewlett, Thomas	5 sus		Hewlett Thomas
96		40	40	45	12	600	1,000	15	1,400	6 sus	Hewlett, Thomas	7 sus		Hewlett Thomas
72	50 ft. poles					175								
72	50 ft. poles					175								
72		24.6	25.5	31.5		500	1,300	15	700	5 sus	Ohio Brass	6 sus		Ohio Brass
102		30.6	3.6	31.1		400	400	9.1	700	5 sus	Ohio Brass	6 sus		Ohio Brass
72		39.1	39.1	39.1		200	320	1.5	500	1 pin	Ohio Brass	6 sus		Ohio Brass
72		30	30	30	12	260	500	2.5	750	5 sus	Thomas, Westinghouse	6 sus		Thomas, Westinghouse
72		30	30	30	12	525	663	15	750	4 sus	Ohio Brass, Locke, Thomas	6 sus		Ohio Brass
84		28	28	28	10	200	300	24	750	5 sus	Ohio Brass	6 sus		Ohio Brass
72		30	30	35	12	525	663	15	750	4 sus	Ohio Brass, Locke	6 sus		Ohio Brass
72		30	30	30	12	525	1,100	6.5		5 sus	Westinghouse, Thomas	6 sus		Westinghouse, Locke
92		25	40	40	15	450	940	14	1,800	6 sus	Ohio Brass	7 sus		Ohio Brass
92		25	40	40	15	450	940	16	1,800	6 sus	Ohio Brass	7 sus		Ohio Brass
92		25	40	40	15	501	715	17	1,800	6 sus	Ohio Brass	7 sus		Ohio Brass
92		25	40	40	15	472	627	18.5	1,800	6 sus	Ohio Brass	7 sus		Ohio Brass
92		25	40	40	15	472	627	18.5	1,800	6 sus	Ohio Brass	7 sus		Ohio Brass
72			31	31	9.5	150	225	12	1,800	Pin	Ohio Brass	Pin		Ohio Brass
144		29.5	39	45	30	863	1,098	16.5	6,000	10 sus	Ohio Brass	11 sus		Ohio Brass
72			22		9.5	150	225	12	1,800	5 sus	Ohio Brass	6 sus		Ohio Brass
60		25	30	32	7	150	250	3	1,600	6 sus	Ohio Brass	7 sus		Ohio Brass
144		25	30	39		880	1,000	14	3,500	1 pin	Ohio Brass	5 sus		Ohio Brass
48		25	30	32	7	150	250	3	1,200	10 sus	Ohio Brass	10 sus		Ohio Brass
144		25	35	40		880	1,000	14	3,500	10 sus	Ohio Brass	10 sus		Ohio Brass
144		25	35	40		880	1,000	14	3,500	10 sus	Ohio Brass	10 sus		Ohio Brass
144		25	35	40		880	1,000	14	3,500	10 sus	Ohio Brass	10 sus		Ohio Brass
120	25 min.	40 min.	50 min.	10-30 min.		880	1,000	32	1,500	9 sus	Ohio Brass, No. 25,620	10 sus		Ohio Brass. No. 25,620
120										9 sus	Ohio Brass, No. 25,620	10 sus		Ohio Brass, No. 25,620
120										9 sus	Ohio Brass, No. 25,620	10 sus		Ohio Brass, No. 25,620
120										9 sus	Ohio Brass, No. 25,620	10 sus		Ohio Brass. No. 25,620
120										9 sus	Ohio Brass, No. 25,620	10 sus		Ohio Brass, No. 25,620
120										9 sus	Ohio Brass, No. 25,620	10 sus		Ohio Brass. No. 25,620
120										9 sus	Ohio Brass, No. 25,620	10 sus		Ohio Brass, No. 25,620
66	28	26	28	4		150	150	1.5		Pin	Ohio Brass		7	Ohio Brass
84	22 min.	24 min.	31 min.	7 min.		250—300	*I*640	2—3	650—600	1 pin	Ohio Brass, No. 12,552	6 sus		Ohio Brass, No. 25,622
60 Vert.—52 Horiz.		25	25	30	8	200	215	3		1 pin	Victor	5 sus		Ohio Brass
60 Vert.—52 Horiz.		25	25	30	8	200	215	3		1 pin	Ohio Brass	5 sus		Ohio Brass
117 Vert.—150 Horiz.		25	25	30	8	660	700	11	700	4 sus	Ohio Brass	5 sus		Ohio Brass
60 Vert.—59 Horiz.		25	25	30	8	175	200	2.25		1 pin	Ohio Brass	5 sus		Ohio Brass
54 Vert.—52 Horiz.		25	25	30	8	132	150	1.5		1 pin	Ohio Brass	5 sus		Ohio Brass
120		30	30	45	50	800	3,200	19	4,000	7 cap and stud	Ohio Brass	8 cap and stud		Ohio Brass
Triangle 84, 156, 180.		26	26	30	12	300	1,800	6	400	5 cap and stud	Ohio Brass	6 cap and stud		Ohio Brass
60 Tri.		22	22	30	6	300	535	9.15	300	Pin	Ohio Brass, 12,855	4 sus		Ohio Brass, 25,622
132 Horiz.		25	24.5	32.5	8.5	550	1,040	15.2	1,850	7 sus	Ohio Brass, 25,622	9 sus		Ohio Brass, 25,622
132 Horiz.		25	24.5	32.5	8.5	550	1,040	15.2	1,850	7 sus	Locke, 8,400	9 sus		Locke, 8,400
132 Horiz.		25	24.5	32.5	8.5	550	900	15.2	1,850	7 sus	Locke, 8,400	9 sus		Locke, 8,400
132 Horiz.		25	24.5	32.5	8.5	550	1,067	15.2	1,850	7 sus	Locke, 8,400	9 sus		Locke, 8,400
78 Horiz.—66 Vert.		22	27	30.0	8	350	850	10.5	460	4 sus	Ohio Brass, 12,464	3 sus		Jeffrey-Dewitt
78 Horiz.—66 Vert.		25		30.0		250	900	10.5		4 sus	Ohio Brass, 25,620	5 sus		Ohio Brass, 25,620

feet on steel towers.

S—Constructed for 132,000 volts.

A—Stations at each end and in center maintain practically 100% regulation.

B—Ground wire bolted solid to towers. Tower legs considered as ground at each tower.

C—Vertical 120 inch, horizontal 216 inch top and bottom arms, 288 inch middle arms.

E—All stations.

F—Also 39.2 miles, section No. 1, copper, normal span 500 ft., normal sag 20 ft.

G—Also 13 miles, No. 2 copper, normal span 150 ft.

H—Constructed in accord to Nat. Elec. Safety Code No. 3.

I—Missouri River crossing; span 3,400 ft. conductor ⅞ extra high strength, galv. steel max. tension per conductor 17,000 lb. (½ inch ice, No. 8 wind, and zero deg. F.). Height of north tower 75 ft., height of south tower 170 ft., difference in elev. of tower bases 126 ft.

J—⅜-inch cu. clad steel.

K—Transformer capacity at 1,200 kva.

L—Now carrying 40,000 volts, for 44,000 volts.

M—Connected and available transformer capacity.

N—N.E.L.A. standard.

e Ohio Brass	None	None		Wood	Wood and steel							
	Yes	None	American Bridge Co.	Steel	Steel		45	10				
	Yes	None	American Bridge Co.	Steel	Steel		50	10				
	Yes	None	American Bridge Co.	Steel	Steel		50	10				
	No	None	H frames	Wood	Wood		25	10				
	Yes	None	Milliken	Steel	Steel		50	10				
	No	None	H frames	Wood	Wood		25	10				
	No	None	H frames	Wood	Wood		25	10				
	No	None	H frames	Wood	Wood		25	10				
	No	None	Single pole	Wood	Steel		25	10				
	None	None	Riter-Conley Milliken	Steel	Steel	Steel		5	None	None		
	None	None	Milliken	Steel	Steel	Steel		5	None	None		
	None	None	Riter-Conley	Steel	Steel	Steel		5	None	None		
	None	None		Wood	Wood	Steel		5	None	None		
	None	None		Wood	Wood	Steel		5	None	None		
No. 25,622	Some	None	Aermotor	Steel	Steel		40		None	None		
	None	None	Aermotor	Steel	Steel		40		None	None		
	Yes	None		Wood	Wood	Steel	30		None	None		
No. 25,622	Yes	None		Wood	Wood	Steel	30		None	None		
No. 25,622	Yes	None		Wood	Wood	Steel	30		None	None		
25,620		None		Steel tower	Steel		45					
		None		Steel tower	Steel							
		None	Milliken	Steel tower	Steel		40					
—Hewlett		None		Steel tower	Steel							
		None	Milliken	Steel pole, steel tower	Steel		55–40					
		None		Wooden H-frame	Wood							
		None		Wood pole	Wood							
		None		Wood pole	Wood	Iron pin	45					
		None		Wood pole	Wood	Iron pin	25					
25,620		None		Wood pole	Wood							
		None		Wood pole	Wood							
		None		Wood pole	Wood							
		None		Wood pole	Wood		40	8.5				
25,620		None		Wood pole	Wood		30					
		None		Wood pole	Wood		40					
		None		Wood pole	Wood		30	5				
Sanitary		None		Wood pole	Wood		30	5				
25,620		None		Wooden H-frame	Wood		30					
		None		Steel tower	Steel							
	Few	None	Milliken	Steel tower	Steel		45					
	Few	None	Milliken	Steel tower	Steel		45	8.7				
	Few	None	Milliken	Steel tower	Steel		45					
y-Dewitt	Yes	No	Modern Steel Str. Co.	Steel	Steel	Steel	42.3		None			
y-Dewitt	Yes	No	Aermotor	Steel	Steel	Steel	42.3		None			
y-Dewitt	Yes	No	Modern Steel Str. Co.	Steel	Steel	Steel	42.3		None			
	Yes	No	Blaw-Knox	Steel	Steel	Steel	42.3		None			
	Yes	No	American Bridge Co.	Steel	Steel	Steel	42.3		None			
	None		Aermotor Blaw-Knox	Steel	Steel		40					
	None		Blaw-Knox	Steel	Steel		45.5					
	None		Blaw-Knox	Steel	Steel		45.5					
	None		Blaw-Knox	Steel	Steel		45.5					
	Yes		Aermotor	Steel	Steel	Steel	38					
	No			Wood	Wood	Steel	27					
	Yes			Wood	Wood	Steel	30					
	No			Wood	Wood	Steel	27					
	No			Wood	Wood	Steel	27					
	No			Wood	Wood	Steel	30					
	No			Wood	Wood	Steel	27					
	No		Aermotor	Steel	Steel	Steel	38					
	No			Wood	Wood	Steel	27					
	No			Wood	Wood	Steel	27					
	No			Wood	Wood	Steel	27					
	Yes			Wood	Wood	Steel	30					
	Yes			Wood	Wood	Steel	27					
	Yes			Wood	Wood	Steel	30					
	Yes		Aermotor	Steel	Steel	Steel	40					
mas	None	None	Poles	Wood	Wood		30	5	None	None		
mas	Yes	None	Blaw-Knox Aermotor	Steel	Steel		40	7	None	None		
	Yes		Aermotor	Steel	Steel		39.6	9.2	None	None		
				Wood	Wood		39.75	3.08	None	None		
				Wood	Steel	Steel	39.6	8.93	None	None		
stinghouse	None	None		Wood	Wood	Steel	28	3				
	Yes	None	Aermotor	Steel	Steel		40	9	2	750		
	Yes	None		Wood	Wood	Steel	28	9				
	Yes	None	American Bridge Co.	Steel	Steel		40	3				
e, Locke	Yes	None	Amer. Br. Co. Aermotor	Steel	Steel		35	5				
	Yes	None	Ritter-Conley	Steel	Steel		44	9.7	1	2,000		
	Yes	None	Ritter-Conley	Steel	Steel		44	9.6	1	5,000		
	Yes	None	Ritter-Conley	Steel	Steel		44	9.8	None			
	Yes	None	Ritter-Conley	Steel	Steel		44	9.9	None			
	Yes	None	Ritter-Conley	Steel	Steel		44	9.9	None			
	None	None		Wood	Wood	Steel	45	2.5	None			
	None	None	American Bridge Co.	Steel	Steel		51	10.0	None			
	None	None		Wood	Wood		45	4.5	None			
	Yes	None		Wood	Wood	Steel	30					
	Yes	None		Wood	Wood	Steel	30					
	Yes	None	American Bridge Co.	Steel	Steel		51					
	Yes	None	American Bridge Co.	Steel	Steel		51					
	Yes	None	American Bridge Co.	Steel	Steel		51					
	Yes	None	American Bridge Co.	Steel	Steel		51					
No. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61	6—7	2	3,000	At 30	
No. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61	At 30,000 kw. per circuit			Kva.	
No. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61					
No. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61					
No. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61					
No. 25,620	Yes	None	American Bridge Co.	Steel	Steel	None	61					
	None	None		Steel	Steel	Steel	35.5	16½				
No. 25,622	None	None	Page-Hill	Wood	Wood	Steel	30–36	8.3	None	None		
				Wood	Wood	Wood	30	5				
				Wood	Wood	Wood	30	5				
	Yes	No	American Bridge Co.	Steel	Steel		42	7.5				
				Wood	Wood	Wood	30	5				
				Wood	Wood	Wood	30	5				
	Rod	None	Riter-Conley	Steel	Steel		55	10	0	0		
	None	None	Blaw-Knox Michelman Riter-Conley	Steel	Steel		35.5	10	2	3,000		
25,622	None	None		Wood	Wood	Steel	32.1					
25,622	None	None		Wood	Wood		43					
	None	None		Wood	Wood		43					
	None	None		Wood	Wood		43					
	None	None		Wood	Wood		43					
tt	None	None		Wood	Wood		25					
25,620	None	None		Wood	Wood		30					

steel.
apacity at Missoula
40,000 volts, designed
l available step up
ard.

O—One wire on top arm grounded approx. every ¼ mile.
P—At 20 degrees Fahr.
Q—Spaced but not insulated for 110,000 volts.
R—Inter-connected system grounded at center and two ends.
S—Choke coils and horn-gaps.
T—Oxide film and multigap.
U—At present operating at 6,600 volts.
V—Two tower line.
W—Maximum tension pounds.
X—16 to 24 ft. between lines, 10 to 15 ft. between phases, 25 ft. in hills, 30 ft. on level ground.
Y—Capacity of frequency changer at Capistrano.
Z—Capacity of transformers at Escondido.
AA—At pit only.
CC—Normal load.
DD—Included in distance of 38.38 miles given above.
EE—No. 6 gal. iron wire on every pole.
FF—Origina
volts, revamp
for 66,000 volt
GG—Hallwa
1908, other ha
HH—Built
built on steel
LL—Rebuilt

	31.25										
	45	10					None	Westinghouse and G. E.	Steel	Each tower	
	50	10						Westinghouse and G. E.	Steel	Each tower	
	50	10						Westinghouse and G. E.	Steel	Each tower	
	25	10						Westinghouse and G. E.	Steel	Each tower	
	50	10						Westinghouse and G. E.	None	None	
	25	10						Westinghouse and G. E.	None	None	
	25	10						Westinghouse and G. E.	None	None	
	25	10						Westinghouse and G. E.	None	None	
	25	10						Westinghouse and G. E.	None	None	
		5	None	None	80		Electro		C.C. steel	Each tower	
		5	None	None	80		Electro		C.C. steel	Each tower	
		5	None	None	80		Electro		C.C. steel	Each tower	
		5	None	None	80		Electro		C.C. steel	Each tower	
		5	None	None	80		Electro		C.C. steel	Each tower	
	40		None	None	97—98	Electro	Electro	Closed delta	½ in. steel	Every tower	
	40		None	None	97—98	Electro	Electro		½ in. steel	Every tower	
	30		None	None	97—98	None	None		None	None	
	30		None	None	97—98	None	None		None	None	
	30		None	None	97—98	None	None		None	None	
	45				80				7/16 in. steel	Each tower	
						Al			7/16 in. steel	Each tower	
	40						Al		½ in. steel	Each tower	
							Al			Each tower	
	55–40						Al		½ in. steel	Each pole, each tower	
					85				½ in. steel	Each pole	
					85				½ in. steel	Each pole	
	45						Al		7/16 in. steel	Each pole	
	25						Al		None		
							Al			Each pole	
									½ in. steel	Each pole	
									½ in. steel	Each pole	
	40	8.5					Al		½ in. steel	Each pole	
	30								½ in. steel	Each pole	
	40						Al		½ in. steel	Each pole	
	30	5					Al		½ in. steel	Each pole	
	30	5							½ in. steel	Each pole	
	30								None		
						Al			½ in. steel	Each tower	
	45					Al			½ in. steel	Each tower	
	45	8.7					Al		½ in. steel	Each tower	
	45						Al		½ in. steel	Each tower	
	42.3		None		90		Electro Westinghouse	Westinghouse	C.C. steel	Each tower	
	42.3		None		90		Electro Westinghouse	Westinghouse	S. M. steel	Each tower	
	42.3		None		90		Electro Westinghouse	Westinghouse	C.C. steel	Each tower	
	42.3		None		90		Electro Westinghouse	Westinghouse	S. M. steel	Each tower	
	42.3		None		90		Electro Westinghouse	Westinghouse	S. M. steel	Each tower	
	40							Al. cell	C.C. steel		
	45.5							Oxide film	None		
	45.5							Oxide film	None		
	45.5							Oxide film	None		
	38							Yes	Steel	Static	
	27							Yes	Steel	Static every pole	
	30							Yes	Steel	Static 4th pole	
	27								Steel	Static every pole	
	27							Yes	Steel	Static 5th pole	
	30							Yes	Steel	Static every pole	
	27							Yes	Steel	Static 5th pole	
	38							Yes	Steel	Static every pole	
	27							Yes	Steel	Static 4th pole	
	27							Yes	Steel	Static 5th pole	
	27							Yes	Steel	Static 5th pole	
	30							Yes	Steel	Static every pole	
	27							Yes	Steel	Static 4th pole	
	30							Yes	Steel	Static every pole	
	40							Yes	Steel	Static every pole	
	30	5	None	None	90	Oxide film	Oxide film	Oxide film	Str. steel	Every 5 poles	
	40	7	None	None	90	Oxide film	Oxide film	Oxide film	None	None	
	39.6	9.2	None	None	90			Electro	S. M. steel	633	
	39.75	3.08	None	None	97			Oxide film	None	None	
	39.6	8.93	None	None	97			Electro	Str. steel	316	
	28	3			80		Oxide film		None	None	
	40	5	2	750	80		Electro		½ in. steel	Towers	
	28	5			80		Oxide film		Steel	Every 1,000 ft.	
	40	3			80		Electro		½ in. steel	Pr. du Sac towers	
	35	5			80		Electro		None	None	
	44	9.7	1	2,000	80	Al. cell	Al. cell		7/16 in. gal. iron	Every 5th tower	
	44	9.6	1	5,000	80	Al. cell	Oxide film		7/16 in. gal. iron	Every 5th tower	
	44	9.8	None		80	Al. cell	Al. cell		7/16 in. gal. iron	Every 5th tower	
	44	9.9	None		80	Al. cell	Al. cell		7/16 in. gal. iron	Every 5th tower	
	44	9.9	None		80	Al. cell	Al. cell		7/16 in. gal. iron	Every 5th tower	
	45	2.5	None		80	Al. cell	Al. cell		None		
	51	10.0	None		80	Al. cell	Oxide film		None		
	45	4.5	None		80	Oxide film	Oxide film		None		
	30					Electro			Steel	Every 2nd pole	
	30					Electro			Steel	Every 2nd pole	
	51					Oil film			None		
	51					Oil film			None		
	51					Oil film			None		
	51					Oil film			None		
	61	6—7	2	3,000	At 30,000		Oxide film		None	None	
	61	At 30,000 kw. per circuit			Kva. 100% to 90% leading	Oxide film			None	None	
	61					Oxide film			None	None	
	61					Oxide film			None	None	
	61					Oxide film			None	None	
	61					Oxide film			None	None	
	61								None	None	
	35.5	16			95			G. E. and Westinghouse	No. 6 iron	300	
	30–36	8.3	None	None	80	Oxide film	Oxide film	Substat. only	None	None	
	30	5			90	Oxide film		Electro	Siemens-Martin	Every 3rd pole	
	30	5			90	Oxide film		Oxide film	Siemens-Martin	Every 3rd pole	
	42	7.5			90	Oxide film		Oxide film electro	High str. steel	Every tower	
	30	5			90	Oxide film		Oxide film	Siemans-Martin	Every 3rd pole	
	30	5			90	Oxide film		Oxide film	Siemans-Martin	Every 3rd pole	
	55	10	0	0	90		0 Electro		Steel		
	35.5	10	2	3,000	100		0 Electro		Steel		
	32.1				80		Oxide film		No. 6 gal. iron	Every pole	
	43				95				No. 6 gal. iron	Every pole	
	43				80				No. 6 gal. iron	Every pole	
	43				80				No. 6 gal. iron	Every pole	
	43								No. 6 gal. iron	Every pole	
	25				80		Al. cell		½ in. S.M. steel	Every pole	
	30				90		Oxide film		½ in. S.M. steel	Every pole	

Capistrano.

Z—Capacity of transformers at Escondido.

AA—At pit only.

CC—Normal load.

DD—Included in distance of 38.38 miles given above.

EE—No. 6 gal. iron wire on every pole.

FF—Originally built in 1914 for 44,000 volts, revamped and reinsulated in 1924 for 66,000 volts.

GG—Hallway Leon to Millbury built in 1908, other half in 1912.

HH—Built on pole line basis in 1902, rebuilt on steel 1921.

LL—Rebuilt for steel towers 1924.

MM—Rebuilt for steel towers 1923.

NN—Reinsulated for 110,000 volts in 1917-18.

PP—Reinsulated in 1923.

QQ—All new construction on steel structures, two circuits per tower.

RR—Above elevation 1,100.

SS—Below elevation 1,100.

TT—For 250,000 c.m. condu

UU—For ½-inch steel conduc

VV—Based on 5% loss.

WW—Based on 10% loss.

XX—Constructed for 132,000

YY—60 degrees Fahr.

ZZ—Ground where high tensi the star side.

wer		2	Wired and carrier	Stations and sub-stations	O. S.	O. S.	Yes	235
wer		1	Wired and carrier	Stations and sub-stations	O. S.	O. S.	Yes	236
wer		1	Wired	Stations and sub-stations	O. S.	O. S.	Yes	237
wer	None		None		O. S.	O. S.	Yes	238
	None		None		O. S.	O. S.	Yes	239
	None		None		O. S.	O. S.	Yes	240
	None		None		O. S.	O. S.	Yes	241
	None		None		O. S.	O. S.	Yes	242
	None		None		O. S.	O. S.	Yes	243
wer		1	Metallic	Towers			Yes	244
wer		2	Metallic	Towers			Yes	245
wer		1	Metallic	Towers			Yes	246
wer		1	Metallic	Poles			Yes	247
wer		1	Metallic	Poles			Yes	248
ower		1	Telephone				Yes	249
ower		1	Bell leased line		Yes			250
			Bell leased line		Yes			251
			Bell leased line		Yes			252
			Bell leased line		Yes			253
wer		2	Telephone	Separate poles			Yes	254
wer		1	Telephone	Separate poles			Yes	255
wer		1	Telephone	Towers			Yes	256
wer		2	Telephone	Separate poles	Yes			257
le, each tower		1	Telephone	Poles, towers			Yes	258
le		1	Telephone	H-frames int. poles			Yes	259
le		1	Telephone		Yes			260
le		1	Telephone	Poles			Yes	261
			Telephone	Poles			Yes	262
le		1	Telephone	Poles	Yes			263
le		1	Telephone	Poles	Yes			264
le		1	Telephone	Poles			Yes	265
le		1	Telephone	Poles			Yes	266
le		1	Telephone	Poles			Yes	267
le		1	Telephone	Poles			Yes	268
le		1	Telephone	Poles			Yes	269
le		1	Telephone	Poles	Yes			270
			Telephone	One leg H-frame			Yes	271
wer		2	Telephone	Separate pole and towers			Yes	272
wer		1	Toll telephone		Yes			273
wer		1	Toll telephone	Separate			Yes	274
wer		1	Toll telephone		Yes			275
wer		2	Telephone No. 12	On Western Union Poles	None			276
wer		2	C. C. steel	Separate poles	None			277
wer		2	C. C. steel	On Western Union poles	None			278
wer		2	C. C. steel	Separate poles	None			279
wer		2	C. C. steel	Separate poles	None			280
		1	Telephone		Yes	Yes	Yes	281
			Bell telephone			Yes		282
			Bell telephone			Yes		283
			Telephone			Yes		284
		1	Leased telephone		Yes			285
very pole		1			Yes			286
th pole		2	Telephone		Yes			287
very pole		2	Telephone		Yes			288
th pole		1			Yes			289
very pole		2	Telephone		Yes			290
th pole		1	Telephone		Yes			291
very pole		1	Telephone		Yes			292
th pole		1	Telephone		Yes			293
th pole		1	Telephone		Yes			294
th pole		1	Telephone		Yes			295
very pole		2	Telephone		Yes			296
th pole		1	Telephone		Yes			297
very pole		2	Leased telephone		Yes			298
very pole		1	Telephone		Yes			299
poles		1	Telephone and carrier current	Under conductor	Oil	Oil	Oil	300
			Carrier current	Ironwood Big Falls	Oil	Oil	Oil	301
								302
								303
		2	Telephone		Airbreak oil	Disconnect oil	Yes	304
	None				Airbreak oil	Disconnect oil	Yes	305
		1			Disconnect oil	Disconnect oil	Yes	306
	None		Leased telephone		Auto oil	Auto oil	Auto oil	307
		2	Leased telephone		Auto oil	Auto oil		308
,000 ft		1	Telephone	On same poles	Auto oil	Auto oil		309
ac towers		2	Telephone	Leased space	Auto oil	Auto oil		310
	None		Leased telephone		Auto oil	Auto oil		311
th tower		1	Bell telephone		G. E. K. O. oil	G. E. H-6 oil		312
th tower		1	Bell telephone		G. E. K. O. oil	G. E. H-6 oil		313
th tower		1	Bell telephone		G. E. K. O. oil	G. E. H-6 oil		314
th tower		1	Bell telephone		G. E. K. O. oil	G. E. H-6 oil		315
th tower		1	Bell telephone		G. E. K. O. oil	G. E. H-6 oil		316
			Bell telephone		G. E. K. O. oil	G. E.		317
			Bell telephone		G. E. K. O. 39 B.	G. E. K. O. 39 B.		318
			Bell telephone		Air break	Air break		319
nd pole		1	Telephone	Pole line			Yes	320
nd pole		1	Telephone	Pole line			Yes	321
			Leased telephone				Yes	322
			Leased telephone				Yes	323
			Leased telephone				Yes	324
			Leased telephone				Yes	325
	None		Telephone	Wood poles			Yes	326
	None		Telephone	Wood poles			Yes	327
	None		Telephone	Wood poles			Yes	328
	None		Telephone	Wood poles			Yes	329
	None		Telephone	Wood poles			Yes	330
	None		Telephone	Wood poles			Yes	331
	None		Telephone	Wood poles				332
		2	Telephone	On pole	Knife	Oil		333
	None		None	None	Air and oil	Oil		334
rd pole		1	Telephone	Same poles 5 ft. under			Yes	335
rd pole		1	None				Yes	336
ower		1	None				Yes	337
rd pole		1	None				Yes	338
rd pole		1	None				Yes	339
1		1	2-wire	Separate poles	Not normally	Yes	Yes	340
1		1	2-wire	On towers	Yes			341
ole			Toll telephone					342
ole			Toll telephone					343
ole			Telephone	Separate poles				344
ole			Carrier current					345
ole			Carrier current					346
ole		1	Telephone	Same poles				347
ole		1						348

c.m. conductor.
steel conductor.
% loss.
10% loss.
d for 132,000 volts.
Fahr.
re high tension side is on

aa—Geometric mean.

bb—At numerous points on the system oxide film or electrolytic arresters are installed sometimes on the bus and sometimes on individual lines.

cc—After renewals and relocations in recent years 5 or 6 suspension type insulators used for strains and dead ends.

Number of Line	Name of Company and Terminals of Transmission Lines	Year During which Line Was Constructed	Capacity of Connected Plants, Kva.		Rating of Line—Kva.			Current		
			Pres.	Ult.	Normal	Maximum	Ultimate	Voltage	Phase	Cycl
1	2	3	4	5	6	7	8	9	10	11
	East South Central States									
	Alabama Power Company									
349	Gadsden—Huntsville	1919	.....	.....	C-C 9,500	11,000	11,000	110,000	3	
350	Guntersville—Boaz	....	.....	.....	C-C 200	.....	.....	22,000	3	
351	Huntsville—Gurley	....	.....	.....	C-C 4,000	.....	.....	22,000	3	
352	Huntsville—Decatur	....	.....	.....	C-C 800	.....	.....	22,000	3	
353	Decatur—Hartselle	....	.....	.....	C-C 100	.....	.....	22,000	3	
354	Warrior Sta.—Empire	....	.....	.....	C-C 7,000	.....	.....	44,000	3	
355	Warrior—Jasper—Quin	....	.....	.....	C-C 7,000	.....	.....	44,000	3	
356	Muscle Shoals—Warrior Sta	....	.....	.....	C-C 7,100	35,000	35,000	110,000	3	
357	Jackson Shoals—Anniston	1913	.....	.....	C-C 19,000	.....	.....	110,000	3	
358	Anniston—Piedmont	1913	.....	.....	C-C 4,700	.....	.....	44,000	3	
359	Anniston—Gadsden	....	.....	.....	C-C 13,000	.....	.....	110,000	3	
360	Gadsden—Attala	1921	.....	.....	C-C 1,400	.....	.....	22,000	3	
361	Gadsden—Lindale	1921	.....	.....	C-C 15,000	.....	.....	110,000	3	
362	Leeds—Magella	1914	.....	.....	C-C 4,500	.....	.....	110,000	3	
363	Magella—Bessemer	1913	.....	.....	C-C 11,000	.....	.....	110,000	3	
364	Bessemer—Lock No. 12	1913	.....	.....	C-C 26,000	.....	.....	110,000	3	
365	Bessemer—Calera	....	.....	.....	C-C 4,900	.....	.....	44,000	3	
366	Tap to Montevallo	....	.....	.....	C-C 900	.....	.....	44,000	3	
367	Superior—Centerville	....	.....	.....	C-C 2,150	.....	.....	44,000	3	
368	Bessemer—Tuscaloosa	....	.....	.....	C-C 8,000	.....	.....	44,000	3	
369	Bessemer—Warrior Sta	1918	.....	.....	C-C 40,000	.....	.....	110,000	3	
370	North Auburn—Sylacauga	....	.....	.....	C-C 2,500	.....	.....	44,000	3	
371	Lock No. 12—Sylacauga	....	.....	.....	C-C 22,000	.....	.....	110,000	3	
372	Sylacauga—Bon Air	....	.....	.....	C-C 1,400	.....	.....	44,000	3	
373	Lock No. 12—Jackson Shoals	1913	.....	.....	C-C 17,500	.....	.....	110,000	3	
374	Jackson Shoals—Leeds	1914	.....	.....	C-C 7,000	.....	.....	110,000	3	
375	Leeds—Lock No. 12	1923	.....	.....	C-C 34,000	.....	.....	110,000	3	
376	Jackson Shoals—Ragland	....	.....	.....	C-C 3,000	.....	.....	44,000	3	
377	Tallassee—Montgomery	....	.....	.....	C-C 9,000	.....	.....	44,000	3	
378	Vida—Marion	....	.....	.....	C-C 3,000	.....	.....	44,000	3	
379	Vida—Lock No. 12	....	.....	.....	C-C 6,000	.....	.....	44,000	3	
380	Lock No. 12—Mitchell Dam	1922	.....	.....	C-C 27,000	.....	.....	110,000	3	
381	Mitchell Dam—Lock No. 18	1923	.....	.....	C-C 5,100	.....	.....	110,000	3	
382	Lock No. 18—Cherokee Bluffs	1923	.....	.....	C-C 5,100	.....	.....	110,000	3	
383	Cherokee Bluffs—No. Auburn	1924	.....	.....	C-C 4,500	.....	.....	110,000	3	
384	No. Auburn—Opelika	1924	.....	.....	C-C 2,000	.....	.....	44,000	3	
385	West Point—No. Auburn	....	.....	.....	C-C 8,000	.....	.....	110,000	3	
386	No. Auburn—Roanoke	....	.....	.....	C-C 2,000	.....	.....	44,000	3	
387	Roanoke—Jackson Shoals	....	.....	.....	C-C 2,000	.....	.....	44,000	3	
388	Roanoke—Rock Mills	....	.....	.....	C-C 270	.....	.....	44,000	3	
389	No. Auburn—Tallassee	....	.....	.....	C-C 600	.....	.....	44,000	3	
390	Natasulga—Tuskegee	....	.....	.....	C-C 400	.....	.....	44,000	3	
391	Tallassee—Union Spr	1924	.....	.....	C-C 500	.....	.....	44,000	3	
392	Tallassee—Cherokee Bluffs	1923	.....	.....	.....	.....	.....	44,000	3	
393	Montgomery—Vida	....	.....	.....	C-C 3,000	.....	.....	44,000	3	
394	Warrior Sta.—Bessemer	....	.....	.....	C-C 7,000	.....	.....	44,000	3	
395	Fairfield—Bessemer	....	.....	.....	C-C 10,000	.....	.....	44,000	3	
396	Jackson Shoals—Anniston	....	.....	.....	C-C 1,000	.....	.....	44,000	3	
	West South Central States—(See end of tabulation for additional lines in this section)									
	Oklahoma Gas & Elec. Co.									
397	Ft. Smith—Muskogee	1923	.....	.....	.....	.....	.....	63,000	3	
398	Muldron—Poteau	1923	.....	.....	.....	.....	.....	63,000	3	
399	Muskogee—Beggs	1919	.....	.....	.....	.....	.....	63,000	3	
400	Beggs—Sapulpa	1920	.....	.....	.....	.....	.....	63,000	3	
401	Sapulpa—Jenks	1920	.....	.....	.....	.....	.....	63,000	3	
402	Sapulpa—Land Spgs	1920	.....	.....	.....	.....	.....	63,000	3	
403	Sepulpa—Drumright	1919	.....	.....	.....	.....	.....	63,000	3	
404	Drumright—Covington	1923	.....	.....	.....	.....	.....	63,000	3	
405	Covington—Enid	1919	.....	.....	.....	.....	.....	63,000	3	
406	Enid—Hennessey	1919	.....	.....	.....	.....	.....	63,000	3	
407	Hennessey—Oklahoma City	1919	.....	.....	.....	.....	.....	63,000	3	
408	Oklahoma City—Moore	1917	.....	.....	.....	.....	.....	63,000	3	
409	Moore—Norman	1917	.....	.....	.....	.....	.....	63,000	3	
410	Oklahoma City—Harrah	1923	.....	.....	.....	.....	.....	63,000	3	
411	Harrah—Byng	1924	.....	.....	.....	.....	.....	63,000	3	
412	Jenks—Tulsa	1920	.....	.....	.....	.....	.....	63,000	3	
413	Briston connecting line	1920	.....	.....	.....	.....	.....	63,000	3	
	Mountain States—(See end of tabulation for additional lines in this section)									
	Truckee River Power Company									
414	Verdi—Bluestone	1910—11	6,000	.....	4,000	.....	.....	63,000	3	
415	Washoe—Summit	1923	.....	.....	7,500	.....	.....	63,000	3	
	Montana Power Company									
416	Madison—Bozeman	1905	212,300	.....	2,500	5,000	.....	50,000	3	
417	Bozeman—Livingston	1906	212,300	.....	2,500	5,000	.....	50,000	3	
418	Livingston—Big Timber	1909	213,300	.....	3,000	5,000	.....	50,000	3	
419	Big Timber—Laurel	1910	212,300	.....	3,000	5,000	.....	50,000	3	
420	Laurel—Billings	1909	212,300	.....	3,000	5,000	.....	50,000	3	
421	Belgrade Jct.—Trident	1910	212,300	.....	2,900	5,000	.....	50,000	3	
422	Logan Tap	1917	212,300	.....	400	600	.....	50,000	3	
423	Park City—Fromberg	1915	212,300	.....	3,000	5,000	10,000	50,000	3	
424	Fromberg—Bridger	1914	212,300	.....	3,000	5,000	.....	50,000	3	
425	Bridger—Red Lodge	1920	212,300	.....	3,000	5,000	.....	50,000	3	
426	Mystic Lake—Red Lodge	1923	212,300	.....	6,000	10,000	.....	50,000	3	
427	Madison—Trident	1909	212,300	.....	3,000	5,000	5,000	50,000	3	
428	Madison—Ruby	1906	212,300	.....	1,500	2,500	.....	50,000	3	
429	Ruby—Twin Bridges	1911	212,300	.....	2,300	4,000	.....	50,000	3	
430	Watters Tunnel Tap	1912	212,300	.....	350	750	.....	50,000	3	
431	Rainbow—Sun River	1913	212,300	.....	3,000	5,000	.....	50,000	3	
432	Sun River—Choteau	1915	212,300	.....	3,000	5,000	.....	50,000	3	
433	Choteau—Conrad	1918	212,300	.....	350	750	.....	50,000	3	
434	Rainbow—Harve	1912	212,300	.....	3,000	.....	.....	50,000	3	
435	Rainbow—Lewistown	1912	212,300	.....	3,000	.....	.....	50,000	3	
436	Lewistown—Harlowton	1916	212,300	.....	3,000	.....	.....	50,000	3	
437	Harlowton—Lavina	1920	212,300	.....	5,250	8,000	.....	50,000	3	
438	Lavina—Roundup	1920	212,300	.....	4,200	.....	.....	50,000	3	
439	Lavina—Billings	1920	212,300	.....	5,250	8,000	.....	50,000	3	
440	Windham—Lehigh	1915	212,300	.....	350	1,000	.....	50,000	3	
441	Big Hole—Butte	1898	212,300	.....	5,800	.....	.....	60,000	3	
442	Canyon Ferry—Butte	1900	Double line	.....	7,500	10,000	.....	60,000	3	
443	Butte—Stuart	1906	Double line	.....	7,500	10,000	.....	60,000	3	
444	Stuart—Deer Lodge	1910	212,300	.....	2,800	.....	.....	60,000	3	
445	Boulder—Radersburg	1909	212,300	.....	2,800	.....	.....	60,000	3	
446	Radersburg—Townsend	1912	212,300	.....	3,000	.....	.....	60,000	3	
447	Butte and Gr. Falls Mine	1915	212,300	.....	300	700	.....	60,000	3	
448	Porphyry Dyke Line	1914	212,300	.....	300	750	.....	60,000	3	
449	Hauser Lake—East Helena	1906	Double line	.....	7,500	10,000	.....	60,000	3	
450	Prickley Pear Taps	1912	Double line	.....	500	1,500	.....	60,000	3	
451	Volta—Two Dot	1915	Double line	.....	17,000	.....	.....	100,000	3	
452	Two Dot—Harlowton	1916	Double line	.....	17,000	.....	.....	100,000	3	
453	Thompson Falls—Crow Creek	1915	Double line	.....	15,000	25,000	.....	100,000	3	
454	East Portal Line—Crow Creek	1915	Double line	.....	15,000	25,000	.....	100,000	3	
455	Thompson Falls—Plains	1913	Double line	.....	3,000	.....	.....	60,000	3	
456	Morel—Anaconda	1915	Double line	.....	15,000	.....	.....	100,000	3	
457	Crow Creek—Burke	1915	Double line	.....	2,000	5,000	.....	100,000	3	
458	Madison—Butte	1909	212,300	.....	17,000	.....	.....	100,000	3	
459	Piedmont & Janney Taps	1915	212,300	.....	17,000	.....	.....	100,000	3	
460	Rainbow—Butte	1910	Double tower	.....	17,000	3,000	.....	100,000	3	
461	Butte—Anaconda	1910	Double tower	.....	17,000	40,000	.....	100,000	3	
462	Butte (G.F. Sub.—Mont. St. Sub.)	1915	212,300	.....	17,000	.....	.....	100,000	3	
463	Volta—Morel	1915	212,300	.....	25,000	.....	.....	100,000	3	
464	Gold Creek Line	1916	212,300	.....	15,000	25,000	.....	100,000	3	
465	Holter—East Helena	1915	212,300	.....	17,000	.....	.....	100,000	3	
466	East Helena—Josephine	1915	213,300	.....	17,000	.....	.....	100,000	3	
467	Volta—Zinc Plant	1915	212,300	.....	25,000	35,000	.....	100,000	3	
468	Electric Furnace Line	1918	212,300	.....	17,000	.....	.....	100,000	3	
	Missoula Public Service Co.									
469	Missoula—Hamilton	1910	K1,000	.....	.....	3,000	.....	L40,000	3	
	Trinidad Elec. Tr. Ry. & Gas Co.									
470	Trinidad—Raton	1914	M1,500	M3,000	.....	.....	.....	44,000	3	
471	Raton—Sugarite	1914	M1,500	M3,000	.....	.....	.....	44,000	3	
472	Raton—Koehler	1914	M1,500	M3,000	.....	.....	.....	44,000	3	
	Public Service Co. of Colo.									
473	Lafayette—Longmont	1906—07	56,000	132,000	.....	.....	.....	44,000	3	
474	Longmont—Loveland	1906—07	56,000	132,000	.....	.....	.....	44,000	3	
475	Loveland—Ft. Collins	1906—07	56,000	132,000	.....	.....	.....	44,000	3	
476	Ft. Collins—Windsor	1906—07	56,000	132,000	.....	.....	.....	44,000	3	
477	Windsor—Greeley	1906—07	56,000	132,000	.....	.....	.....	44,000	3	
478	Greeley—Ft. Lupton	1910	56,000	132,000	.....	.....	.....	44,000	3	
479	Ft. Lupton—Puritan	1910	56,000	132,000	.....	.....	.....	44,000	3	

rrent			Line Connections						Conductors			
					Grounding							
Phase 10	Cycles 11	Step-up 12	Step-down 13	Solid Neutral 14	Reistance, Amount 15	Locations 16	Circuits per Tower 17	Length in Single Circuit Miles 18	Section—Gage or CirMil. 19	Material 20		
3	60	2,300—22,000—110,000	110,000—22,000	Yes		Huntsville	1	62.6	1/0	Al		
3	60						1	19.2	No. 4	Cu		
3	60		110,000—22,000				1	15.6	No. 6	Cu		
3	60						2	DD38.4	No. 2	Cu		
3	60						1	DD	No. 4	Cu		
3	60	13,200—44,000	44,000—2,300				1	24.5	No. 4	Cu		
3	60	13,200 to 44,000	44,000—2,300				1	79.2	No. 4	Cu		
3	60	12,000 to 110,000					1	88.2	250,000	Cu		
3	60	2,300—44,000	110,000—44,000	Yes		Jackson Shoals	2	23.0	2/0	Cu		
3	60		110,000—44,000	Yes		Anniston	1	24.1	No. 1—No. 4	Cu		
3	60						2	25.9	No. 1	Cu		
3	60						1	10.9				...
3	60						1	35.7	3/0	A. C. S. R		
3	60		110,000—44,000—13,200	Yes		Leeds	2	16.4	2/0	Cu		
3	60		110,000—13,200	Yes		Magella	2	6.7	2/0	Cu		
3	60		110,000—44,000	Yes		Bessemer	2	39.9	2/0	Cu		
3	60						1	29.7	No. 4	Cu		
3	60						1	11.0	No. 4	Cu		
3	60						1	29.3	No. 4	Cu		
3	60						1	18.4, 21.1	No. 4—4/0—2/0	Cu.—Al.—Al		
3	60						2	25.4	2/0	Cu		
3	60						1	25.3—35.9	No. 2—No. 4	Cu		
3	60						2	22.0	2/0	Cu		
3	60		110,000—44,000	Yes		Sylacaga	1	19.6	No. 4	Cu		...
3	60						2	26.6	2/0	Cu		
3	60						2	28.9	2/0	Cu		
3	60						1	38.6	397,500	A. C. S. R		
3	60						1	13.6	No. 2	Cu		
3	60	2,300—44,000		Yes		Tallassee	2	39.5	2/0	Al		
3	60						1	49.3				...
3	60						1	28.8	3/0	Al		
3	60	6,600—44,000—110,000		Yes		Lock No. 12	2	12.2	350,000	Cu		
3	60	6,600—110,000		Yes		Mitchell	1	18.5	397,500	A. C. S. R		
3	60						1	20.6	397,500	A. C. S. R		
3	60		110,000—44,000	Yes		Cherokee	1	26.9	2/0	Cu		
3	60		110,000—44,000	Yes		N. Auburn	1	4.7				...
3	60						1	9.8	4/0	A. C. S. R		
3	60						1	36.3	No. 4	Cu		
3	60						1	67.0	No. 4	Cu		
3	60						1	4.6				...
3	60						1	35.4	No. 4	Cu		
3	60						1	8.4	No. 4	Cu		
3	60	2,300—44,000		Yes		Tallassee	1	31.5	2/0	Al		
3	60						2	7.5	2/0	Al		
3	60						1	29.9	3/0	Al		
3	60						1	9.7—8.0	2/0—4/0	Cu.—Al		
3	60						2	10.5	2/0	Cu		
3	60						1	23.0	No. 4	Cu		
3	60						1	85	3/0	Cu		
3	60						1	33.5	1/0	Cu		
3	60						1	39	No. 3	Cu		
3	60						1	21	No. 3	Cu		
3	60						1	10.5	No. 3	Cu		
3	60						1	10	No. 3	Cu		
3	60						1	28	No. 3	Cu		
3	60						1	77	3/0	Cu		
3	60						1	21	3/0	Cu		
3	60						1	22	3/0	Cu		
3	60						1	69	No. 3	Cu		
3	60						1	11	No. 3	Cu		
3	60						1	10	No. 4	Iron		
3	60						1	22.5	3/0	Cu		
3	60						1	74	No. 0	Cu		
3	60						1	10	No. 1	Al		
3	60						1	12	No. 3	Cu		
3	60	None	3	None	None		1	70.2	No. 4	Str. Cu		
3	60	None	3	None	None		1	31.3	No. 2	Solid Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	44	41,700	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	25	26,500	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	33.4	49,400	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	66	49,530	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	16.8	45,700	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	18	49,500	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	1	49,500	Steel		
3	60			Yes	None	Harlowton—Mystic Lake	1	16.5	49,500	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	6.8	49,500	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	19.7	49,500	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	26.7	105,000	Cu		
3	60	Delta	Delta	Yes	None	Harlowton—Mystic Lake	1	36	50,000	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	25.5	26,250	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	19.8	40,000	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	8.0	62,000	Steel		
3	60			Yes	None	Harlowton—Mystic Lake	1	72.0	49,500	Steel		
3	60			Yes	None	Harlowton—Mystic Lake	1	16.0	49,500	Steel		
3	60			Yes	None	Harlowton—Mystic Lake	1	29.9	62,000	Iron		
3	60			Yes	None	Harlowton—Mystic Lake	1	107.7	49,500	Cu		
3	60			Yes	None	Horlawton—Mystic Lake	1	118.1	49,500	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	56.3	49,500	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	45.3	91,650	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	20.6	72,660	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	45	91,650	Cu		
3	60			Yes	None	Harlowton—Mystic Lake	1	4.9	62,000	Iron		
3	60			None			1	21.8	83,690	Solid Cu		
3	60			None			1	126	105,000	Cu		
3	60			None			1	29	105,000	Cu		
3	60			None			1	24	41,750	Cu		
3	60			None			1	24	41,750	Cu		
3	60			None			1	11.8	49,500	Cu		
3	60			None			1	6	49,500	Iron		
3	60			None			1	14.2	49,500	Iron		
3	60			None			1	26.4	105,000	Cu		
3	60			None			1	3	49,500	Iron		
3	60			Yes	None	Anac. Butte Harlorth	1	102.3	115,000	Cu		
3	60			Yes	None	Anac. Butte Harlorth	1	12.6	115,000	Cu		
3	60	Delta	Star	Yes	None	Anac. Butte Burke	1	20.3	133,000	Cu		
3	60			Yes	None	Anac. Butte Burke	1	22.7	115,000	Cu		
3	60			None			1	32.4	49,500	Cu		
3	60			Yes		Anac. Butte Harlow	1	7.9	115,000	Cu		
3	60	Delta	Star	Yes	None	Butte Anaconda Burke	1	27.7	133,000	Iron		
3	60			Yes		Anaconda Butte	1	61	105,000	Cu		
3	60			Yes		Anaconda Butte	1	3.5	105,000	Cu		
3	60			Yes		Anaconda Harlow Butte	1	260	105,000	Cu		
3	60			Yes		Anaconda Harlow Butte	1	20.5	105,000	Cu		
3	60			Yes		Anaconda Harlow Butte	1	2.5	105,000	Cu		
3	60			Yes		Anaconda Harlow Butte	1	133.8	211,000	Cu		
3	60			Yes		Anaconda Harlow Butte	1	15.4	133,000	Cu		
3	60			Yes		Anaconda Harlow Butte		31	115,000	Cu		
3	60			Yes		Anaconda Harlow Butte		54.5	115,000	Cu		
3	60			Yes		Anaconda Harlow Butte		7.5	211,000	Cu		
3	60			Yes		Anaconda Harlow Butte		0.8	115,000	Cu		
3	60	11,000 to 40,000	40,000—3,300—2,200				1	50	No. 4	Cu		
3	60			None	None		1	25	No. 3	Cu		
3	60			None	None		1	8	No. 4	Iron		
3	60			None	None		1	24	No. 3—No. 4	Cu.—Iron		
3	60		44,000—6,600—2,300	None	None		1	13.5	2/0	Cu		
3	60		44,000—6,600—2,300	None	None		1	16	2/0	Cu		
3	60		44,000—6,600—2,300	None	None		1	12	1/0	Cu		
3	60		44,000—6,600—2300	None	None		1	11	No. 4	Cu		
3	60		44,000—6,600—2,300	None	None		1	12	No. 4	Cu		
3	60		44,000—6,600—2,300	None	None		1	21	1/0	Cu		

Conductors							Span				Insulators per Conductor			
			Clearance, Ft.								Straight Run		Strain	
CirMil.	Material 20	Spacing Inches 21	To Ground 22	To Highway 23	To Tracks 24	From Line to Telephone 25	Normal Feet 26	Maximum Feet 27	Normal Sag—Feet 28	Normal Tension Pounds 29	No. of Units and Type 30	Manufacturer 31	No. of Units and Type 32	
1/0	Al	212	5	30	30	18	600		10		7		8	
	Cu	57	2	20	30	10	200		5		Pin		Pin	
	Cu	57	2	20	30	10	200		5		Pin		Pin	
	Cu	57	2	20	30	10	200		5		Pin		Pin	
	Cu	57	2	20	30	10	200		5		Pin		Pin	
	Cu	57	3	25	30	15	300		5		Pin		Pin	
	Cu	57	3	25	30	15	300		5		Pin		Pin	
250,000	Cu	212	5	25	30	18	300		5		7	Ohio Brass	8	Ohio
2/0	Cu	154	5	30	30	18	600	1,300	10		7		8	
	Cu	57	3	25	30	15	300		5		Pin		Pin	
	Cu	136	5	30	30	18	600		10		7		8	
			2	25	30	10	250		3		Pin		Pin	
3/0	A. C. S. R	212	5	30	30	18	500		10		7		8	
2/0	Cu	154	5	30	30	18	600	2,000	10		7		8	
2/0	Cu	154	5	30	30	18	600		10		7		8	
2/0	Cu	154	5	30	30	18	600	1,300	10		7		8	
	Cu	58	3	25	30	15	300		5		Pin		Pin	
	Cu	58	3	25	30	15	300		5					
	Cu	58	3	25	30	15	300		5					
	Cu.—Al.—Al	53—53—57	3	25	30	15	300		5		Pin		Pin	
2/0	Cu	154	5	30	30	18	500		10		7		8	
	Cu	36—57	3	25	30	15	300		5		Pin		Pin	
2/0	Cu	154	5	30	30	18	600		10		7		8	
	Cu		3	25	30	15	250		5		Pin		Pin	
2/0	Cu	154	5	30	30	18	600		10		7		8	
2/0	Cu	154	5	30	30	18	600		10		7		8	
397,500	A. C. S. R		5	30	30	18	500	2,000	10		7	—	8	
	Cu	57	3	25	30	15	250		5		Pin		Pin	
2/0	Al	212	3	25	30	15	250		5		Pin		Pin	
											Pin		Pin	
3/0	Al	57	3	25	30	15	250		5					
350,000	Cu	154	5	30	30	18	250		5		7		8	
397,500	A. C. S. R	212	5	30	30	18	600		10		7		8	
397,500	A. C. S. R	212	5	30	30	18	500		10		7		8	
2/0	Cu	212	5	30	30	18	500		10		7		8	
											Pin		Pin	
4/0	A. C. S. R	212	5	30	30	18	500		10		7		8	
	Cu	81	3	25	30	15	250		5		Pin		Pin	
	Cu	81—57	3	25	30	15	250		5					
			3	25	30	15	250		5					
	Cu	57	3	25	30	15	250		5		Pin		Pin	
	Cu	57	3	25	30	15								
2/0	Al	212	3	25	30	15								
2/0	Al	212	3	25	30	15								
3/0	Al	77	3	25	30	15								
	Cu.—Al	57	3	25	30	15								
2/0	Cu	57	3	25	30	15								
	Cu	81	3	25	30	15								
3/0	Cu	72	22	24	32	6	300	325	4		4 discs	Ohio Brass	5 discs	Ohi
1/0	Cu	72	22	24	32	6	300	325	5		4 discs	Ohio Brass	5 discs	Ohi
	Cu	72	22	24	32	6	325	350	8		4 discs	Ohio Brass	5 discs	Ohi
	Cu	72	22	24	32	6	325	350	8		4 discs	Ohio Brass	5 discs	Ohi
	Cu	72	22	24	32	6	325	350	8		4 discs	Ohio Brass	5 discs	Ohi
	Cu	72	22	24	32	6	325	350	8		4 discs	Ohio Brass	5 discs	Ohi
	Cu	72	22	24	32	6	300	325	8		4 discs	Ohio Brass	5 discs	Oni
3/0	Cu	72	22	24	32	6	300	325	4		4 discs	Ohio Brass	5 discs	Hev
3/0	Cu	72	22	24	32	6	325	350	4		4 discs	Ohio Brass	5 discs	Hev
3/0	Cu	72	22	24	32	6	325	350	4		4 discs	Ohio Brass	5 discs	Ohi
	Cu	72	22	24	32	6	325	350	8		4 discs	Ohio Brass	5 discs	Ohi
	Cu	72	22	24	32	6	325	350	8		4 discs	Ohio Brass	5 discs	Ohi
	Iron	72	22	24	32	6	325	350	8		4 discs	Ohio Brass	5 discs	Ohi
3/0	Cu	72	22	24	32	6	300	325	3		4 discs	Ohio Brass	5 discs	Ohi
	Cu	72	22	24	32	6	300	325	4.5		4 discs	Ohio Brass	5 discs	Ohi
	Al	72	22	24	32	6	325	350			4 discs	Ohio Brass	5 discs	Ohi
	Cu	72	22	24	32	6	240	250	3		Pin	Ohio Brass	5 discs	Ohi
	Str. Cu	144	35	35	34	8	300				1 pin		2 sus	
	Solid Cu	84	45	45	55	8	150	350.5			1 pin		Dead end pin	
41,700	Cu	78	25	26	35	7.1	150	300			Glass 9 in	Hemmingway	3 sus	Ohi
26,500	Cu	78	25	26	35	7.1	150	300			Glass 9 in	Hemmingway	3 sus	Ohi
49,400	Cu	78	25	26	35	7.0	130	300			Glass 9 in	Hemmingway	3 sus	Ohi
49,530	Cu	66	25	26	35	5.5	300	600			3 perc. A—1	Ohio Brass	3 sus	Ohi
45,700	Cu	78	25	26	35	7.0	120	300			3 sus	Ohio Brass	3 sus	Ohi
49,500	Cu	66	25	26	35	5.6	300	500			Glass 9 in	Hemmingway	3 sus	Ohi
49,500	Steel	66	25	26	35	5.1	300	300			3 sus	Ohio Brass	3 sus	Ohi
49,500	Cu	66	25	26	35	5.5	300	400			3 sus	Ohio Brass	3 sus	Ohi
49,500	Cu	43	25	26	35	6.0	300	400			Glass 7 in	Hemmingway	3 sus	Ohi
49,500	Cu	43	25	26	35	6.0	225	400			Pyrex Gl's 7 in	Corning Glass Wks	4 sus	Ohi
105,000	Cu	54	25	26	35	6.0	140	400			Glass 9 in	Hemmingway	3 sus	Ohi
50,000	Cu	78	25	26	30	6.0	140	400			Glass 9 in	Hemmingway	3 sus	Ohi
26,250	Cu	78	25	26	30	7.1	150	300			Glass 9 in	Hemmingway	3 sus	Ohi
40,000	Cu	78	25	26	35	5.5	350	600			3 sus. A—1	Ohio Brass	3 sus	Ohi
62,000	Steel	78	25	26	35	5.5	350	600			3 sus. A—1	Ohio Brass	3 sus	Ohi
49,500	Steel	66	25	26	35	5.1	350	600			4 sus. A—1	Ohio Brass	4 sus	Ohi
49,500	Steel	66	25	26	35	5.1	350	500			Woodstick		3 sus	Ohi
62,000	Iron	66	25	26	35	5.1	350	450			Woodstick	Ohio Brass	3 sus	Ohi
49,500	Cu	66	25	26	35	5.1	350	550			4 sus. A—1	Ohio Brass	4 sus	Ohi
49,500	Cu	66	25	26	35	5.1	350	1,100			4 sus. A—1	Ohio Brass	4 sus	Oni
49,500	Cu	66	25	26	35	5.1	350	600			4 sus	Ohio Brass	4 sus	Ohi
91,650	Cu	43	25	26	35	6.0	300	400			Glass 7 in	Hemmingway	4 sus	Ohi
72,660	Cu	43	25	26	35	6.0	300	400			Glass 7 in	Hemmingway	3 sus	Ohi
91,650	Cu	43	25	26	35	6.0	300	400			Glass 7 in	Hemmingway	3 sus	Ohi
62,000	Iron	66	25	26	35	5.1	350	500			4 sus	Ohio Brass, No. 9,403	4 sus	Ohi
83,690	Solid Cu	60	25	26	35	5	220	300			Glass, 7 in	Hemmingway	4	Ohi
105,000	Cu	78	25	26	35	6	110	200			Glass, 9 in	Hemmingway	Glass, 9 in	Hei
105,000	Cu	78	25	26	35	6	130	175			Glass, 9 in	Hemmingway	Glass, 9 in	Hei
41,750	Cu	78	25	26	35	6	225	300			Glass, 9 in	Hemmingway	Glass, 9 in	Hei
41,750	Cu	78	25	26	35	6	225	300			Glass, 9 in	Hemmingway	Glass, 9 in	Hei
49,500	Cu	78	25	26	35	6	250	350			Glass, 9 in	Hemmingway	Glass, 9 in	Hei
49,500	Iron	78	25	26	35	6	225	350			Glass, 9 in	Hemmingway	Glass, 9 in	Hei
49,500	Iron	60	25	26		5	350				Glass, 9 in	Hemmingway	4 sus	Ohi
105,000	Cu	78	25	26	35	6	130	250			Glass, 9 in	Hemmingway	Glass, 9 in	Ohi
49,500	Iron	78	25	26	35	6	225	300			Glass, 9 in	Hemmingway	4 sus	Ohi
115,000	Cu	126	25	26	35	8.5	440	900			6 sus	Locke	6 sus	Loc
115,000	Cu	126	25	26	35	8.5	440	600			6 sus	Ohio Brass	6 sus	Ohi
133,000	Cu	126	25	26	35	8.5	440	900			6 sus	Ohio Brass	6 sus	Ohi
115,000	Cu	126	25	26	35	8.5	440	800			6 sus	Ohio Brass	6 sus	Ohi
49,500	Cu	66	25	26	35	5.1	350	450			3 sus	Ohio Brass	3 sus	Ohi
115,000	Cu	126	25	26	35	8.5	440	600			6 sus	Ohio Brass	6 sus	Ohi
133,000	Iron	126	25	26	35	8.5	440	1,100			6 sus	Ohio Brass	6 sus	Ohi
105,000	Cu	124	25	26	35	200	500	1,300		1,000	6 sus	Thomas	6 sus	Th
105,000	Cu	126	25	26	35	8.5	440	600		1,000	6 sus	Ohio Brass	6 sus	Ohi
105,000	Cu	124	25	26	35	30	660	12,600		1,000	6 sus	Ohio Brass	6 sus	Ohi
105,000	Cu	124	25	26	35	9.2	660	900		1,000	6 sus	Ohio Brass	6 sus	Ohi
105,000	Cu	120	30	30	35	8	200	200		1,000	6 sus	Ohio Brass	6 sus	Ohi
211,000	Cu	126	25	26	35	40	440	1,000			6 sus	Ohio Brass	6 sus	Ohi
133,000	Cu	126	25	26	35	8.5	440	700			6 sus	Ohio Brass	6 sus	Ohi
115,000	Cu	126	25	26	35	8.5	440	800		1,100	6 sus	Ohio Brass	6 sus	Ohi
115,000	Cu	126	25	26	35	8.5	440	800		1,100	6 sus	Ohio Brass	6 sus	Ohi
211,000	Cu	126	25	26	35	8.5	440	500		2,000	6 sus	Locke	6 sus	Loc
115,000	Cu	126	30	35	40		500	600			6 sus	Thomas	6 sus	Th
	Cu	48	25	30	28		140	150	2		3	Ohio Brass		
	Cu	60	20—30	26	30	8	175—250	800			1	Various	4	We
	Iron	60	20—30	26	30	8	175—250	800			1	Various	4	We
	Cu.—Iron	60	20—30	26	30	8	175—250	800			1	Various	4	We
2/0	Cu	48	N	N	N	N	125	150	Std	Std	Pin	Ohio Brass, Thomas, West	3	He
2/0	Cu	48	N	N	N	N	125	150	Std	Std	Pin	Ohio Brass, Thomas, West	3	He
1/0	Cu	48	N	N	N	N	125	150	Std	Std	Pin	Ohio Brass, Thomas, West	3	He
	Cu	48	N	N	N	N	125	150	Std	Std	Pin	Ohio Brass, Thomas, West	3	He
	Cu	48	N	N	N	N	125	150	Std	Std	Pin	Ohio Brass, Thomas, West	3	He
1/0	Cu	48	N	N	N	N	125	150	Std	Std	Pin	Ohio Brass, Thomas, West	3	He
1/0	Cu	48	N	N	N	N	125	150	Std	Std	Pin	Ohio Brass, Thomas, West	3	He
1/0	Cu	48	N	N	N	N	125	150	Std	Std	Pin	Ohio Brass, Thomas, West	3	He

or Strain Units type 2	Strain Manufacturer 33	Arcing Horns or None 34	Shield Rings or None 35	Towers Manufacturer 36	Towers Wood, Concrete or Steel 37	Towers Cross Arms—Steel or Wood 38	Towers Pins—Steel or Wood 39	Towers Tower Height, Feet to Lowest Conductor 40	R Normal (Per Cent) 41	S Co No. Un 4
8					Steel	Steel	Wood	40	3.8	
					Wood	Wood	Wood	30		
					Wood	Wood	Wood	30		
					Wood	Wood	Wood	30		
					Wood	Wood	Wood	30		
					Wood	Wood	Wood	30	10.0	
					Wood	Wood	Wood	30	10.0	
8					Wood	Wood		40	4.3	
8	Ohio Brass				Steel	Steel		40	1.4	
					Wood	Wood	Steel	30	10.0	
8					Steel	Steel		40	0.5	
					Wood	Wood	Wood	30	10.0	
8					Wood	Wood		40		
8					Steel	Steel		40	1.0	
8					Steel	Steel		40	1.0	
8					Steel	Steel		42	5.3	
					Wood	Wood	Steel	30	5.0	
								30	5.0	
								30	5.0	
					Wood	Wood	Steel	30	10.0	
8					Wood, steel	Steel		40	2.7	
					Wood	Wood	Steel	30	5.0	
8					Steel	Steel		40	3.1	
					Wood	Wood	Steel	30	10.0	
8					Steel	Steel		40	1.4	
8								40	0.9	
8								40	5.3	
					Wood	Wood		40	10.0	
					Wood	Wood	Steel	30	4.0	
					Wood	Wood	Steel	30	5.0	
					Wood	Wood	Steel	30	5.0	
					Wood	Wood	Steel	30	5.0	
8					Wood	Wood		40	1.9	
8					Steel	Steel		40	2.0	
8					Wood	Wood		40	2.0	
8								40	2.0	
							Steel	30	5.0	
8								40		
							Steel	30	5.0	
								30	5.0	
								30		
					Wood	Wood	Steel	30	5.0	
								30	5.0	
								30	10.0	
								30	5.0	
								30	5.0	
								30	6.0	
								30	4.0	
								30	5.0	
	Ohio Brass	Yes	None		Wood	Steel		45		
	Ohio Brass	Yes	None		Wood	Steel		45		
	Ohio Brass	None	None		Wood	Steel		50		
	Ohio Brass	None	None		Wood	Steel		55		
	Ohio Brass	None	None		Wood	Steel		50		
	Ohio Brass	None	None		Wood	Steel		55		
	Ohio Brass	None	None		Wood	Steel		50		
	Onio Brass	None	None		Wood	Steel		45		
	Hewlett	Yes	None		Wood	Steel		55		
	Hewlett	Yes	None		Wood	Steel		45—H frame		
	Ohio Brass	None	None		Wood	Steel		45		
	Ohio Brass	None	None		Wood	Steel		45		
	Ohio Brass	None	None		Wood	Steel		45		
	Ohio Brass	None	None		Wood	Steel		45		
	Ohio Brass	Yes	None		Wood	Steel		45		
	Ohio Brass	Yes	None		Wood	Steel		50		
	Ohio Brass	Yes	None		Wood	Steel		40		
	Ohio Brass	None	None		Wood	Steel	Steel	40		
end pin		None	None		Wood	Wood	Steel	35		
		None	None		Wood	Wood	Steel	45		
	Ohio Brass	None	None		Wood	Wood	Wood	30

Pins—Steel or Wood 39	Tower Height, Feet to Lowest Conductor 40	Regulation: Normal (Per Cent) 41	Regulation: Synchronous Condensers, Kva. No. of Units 42	Regulation: Synchronous Condensers, Kva. Total Capacity 43	Regulation: P. F. at Normal Load 44	Arresters—Type: Bus 45	Arresters—Type: Lines 46	Arresters—Type: Transformers 47	Ground: Material 48	Ground: No. of Ground 49
	40	3.8	1	5,000	98	Electro		Electro	Steel	Each tower
Wood	30						Bennett	Electro	Steel	
Wood	30		1	7,500					Steel	
Wood	30								Steel	
Wood	30								Steel	
Wood	30	10.0			80		Electro		Steel	
Wood	30	10.0			80		Electro		Steel	
	40	4.3	2	7,500	98		Electro		Steel	Each tower
	40	1.4			98 lag	Electro			Steel	Each tower
teel	30	10.0			80 lag		Electro			
	40	0.5			98 lag	Electro				Each tower
Wood	30	10.0			80 lag		Electro			
	40								Steel	Each tower
	40	1.0	1	12,500	98 lag	Oxide film electro			Steel	Each tower
	40	1.0			98 lag	Electro			Steel	Each tower
	42	5.3	1	15,000	98 lag	Electro	Electro		Steel	Each tower
teel	30	5.0			80 lag		Electro			
	30	5.0			80 lag					
	30	5.0			80 lag					
teel	30	10.0			80 lag		Electro		Steel	
	40	2.7			98 lag	Electro	Electro		Steel	Each tower
teel	30	5.0			80 lag		Electro		Steel	
	40	3.1			98 lag	Electro			Steel	Each tower
teel	30	10.0			80 lag		Electro		Steel	
	40	1.4			98 lag				Steel	Each tower
	40	0.9			98 lag					
	40	5.3			98 lag		Electro			
teel	30	10.0			80 lag		Electro			
teel	30	4.0			80 lag				Steel	
teel	30	5.0			80 lag				Steel	
teel	30	5.0			80 lag	Electro				
	40	1.9			98 lag					Each tower
	40	2.0			98 lag					
	40	2.0			98 lag			Bennett		
	40	2.0			98 lag	Electro				
teel	30	5.0			80	Electro				
	40									
teel	30	5.0			80 lag					
	30	5.0			80 lag		Electro			
	30									
teel	30	5.0			80 lag				Steel	
	30	5.0			80 lag					
	30	10.0			80 lag	Oxide film				
	30	5.0			80 lag		Electro			
	30	5.0			80 lag					
	30	6.0			85 lag		Electro			
	30	4.0			85 lag					
	30	5.0			80 lag		Electro			
	45							Electro	No. 4 iron	Each pole
	45							Oxide film	No. 4 iron	Each pole
	50							Oxide film electro	No. 4 Iron	Each pole
	55							Oxide film electro	No. 4 iron	Each pole
	50							Oxide film electro	No. 4 iron	Each pole
	55							Oxide film electro	No. 4 iron	Each pole
	50							Oxide film electro	No. 4 iron	Each pole
	45							Oxide film	No. 4 iron	Each pole
	55							Oxide film	No. 4 iron	Each pole
	45—H frame							Oxide film	No. 4 iron	Each pole
	45							Oxide film	No. 4 iron	Each pole
	45								No. 4 iron	Each pole
	45								No. 4 iron	Each pole
	45								No. 4 iron	Each pole
	50								No. 4 iron	Each pole
teel	40								No. 4 iron	Each pole
Steel	35									None
Steel	45									None
Wood	30					Al. cell	None	None		None
Wood	30					Al. cell	None	None		
Wood	30					Al. cell	None	None	Steel	Every 2nd po
Wood	30					Al. cell	None	None	Steel	Every 2nd po
Wood	30					Al. cell	None	None	Steel	Every 1,500 f
Wood	30					Al. cell	None	None	Steel	Every 600 f
Wood	30					None	None	None	Steel	Every 600 f
Wood	30					None	None	None	Steel	Every 600 f
Wood	30					None	None	None	Steel	Every 600 f
Wood	30					None	None	None	Steel	Every 600 f
Wood	30					None	None	None	None	
Wood	29					Al. cell			Steel	Every 700 ft
Wood	25					Al. cell			None	
Wood	31					Al. cell	None	None	Steel	Every 700 ft
Wood	30					Al. cell			Steel	Every 700 ft
Wood	30					Al. cell			Steel	Every 700 ft
Wood	30					Sw. con	None	None	Steel	Every 700 ft
Wood	30					Sw. con	None	None	Steel	Every 700 ft
Wood	30					Al. cell	None	None	Steel	Every 700 ft
Wood	30					Al. cell	None	None	Steel	Every 700 ft
Wood	30					Al. cell	None	None	Steel	Every 700 ft
Wood	29					Al. cell	None	None	Steel	Every 600 ft
Wood	30		None			Sw. con	None	None	Steel	Every 600 ft
Wood	30		None			Al. cell	None	None	Steel	Every 600 ft
Wood	30		None			Al. cell	None	None	Steel	Every 700 ft
Wood	30		None			Al. cell—Low eq.	None	None	None	
Wood	25		None			Al. cell—Low eq.	None	None	None	
Wood	25		None			Al. cell—Low eq.	None	None	None	
Wood	30		None			Water resist	None	None	None	
Wood	30		None			Al. cell	None	None	None	
Wood	25		None			None	None	None	None	
Wood	25		None			None	None	None	None	
Wood	30					Low eq.	None	None	None	
Wood	25					Al. cell				
Wood	25					Al cell	None	None	None	
Wood	34					Al. cell	None	None	Steel	Every 800 ft
Wood	34					Al. cell	None	None	Steel	Every 800 ft
Wood	34					Al. cell	None	None	Steel	Every 800 ft
Wood	34					Al. cell	None	None	Iron	Every 800 ft
Wood	34					Al. cell	None	None	Steel	Every 700 ft
Wood	34					Al. cell	None	None	Steel	Every 880 ft
Wood	34					Al. cell	None	None	Steel	Every 880 ft
	40		None	None		Al. cell	None	None	Steel	Every tower
	34		None	None		Al. cell	None	None	Steel	Every tower
	40					Al. cell	None	None	Steel	Every tower
	40		None	None		None	Al. cell	None	Steel	Every tower
	38		None	None		Al. cell	None	None	Steel	Every 2nd po
	34		None	None		Al. cell	None	None	Steel	Every tower
	34		None	None		Al. cell	None	None	Steel	Every 2nd to
	34		None	None		Al. cell	None	None	Steel	Every 2nd to
	34		None	None		Al. cell	None	None	Steel	Every 2nd to
	34		None	None		Al. cell	None	None	Steel	Every 2nd to
	40		None	None		Al. cell	None	None	Steel	Every tower
						Electro	Electro	Stevensville—Hamilton	Iron	
Steel	30					Electro	Electro		None	None
Steel	30					Electro	Electro		None	None
Steel	30					Electro	Electro		None	None
Steel		10			60—90	Oxide film electro	Oxide film electro		None	None
Steel		10			60—90	Oxide film electro	Oxide film electro		None	None
Steel		10			60—90	Oxide film electro	Oxide film electro		None	None
Steel		10			60—90	Oxide film electro	Oxide film electro		None	None
Steel		10			60—90	Oxide film electro	Oxide film electro		None	None
Steel		10			60—90	Oxide film electro	Oxide film electro		None	None
Steel		10			60—90	Oxide film electro	Oxide film electro		None	None

Ground Wire		Communication		Switching			
No. of Ground Wires 49	No. of Wires 50	Type 51	Location 52	H.T. 53	L.T. 54	Both H.T and L.T. 55	Number of Line 56
Each tower	1						349
	1						350
	1						351
	1						352
	1						353
	1						354
	1						355
Each tower	2						356
Each tower	1						357
	1						358
Each tower	1						359
							360
Each tower	1						361
Each tower	2						362
Each tower	2						363
Each tower	2						364
	1	Telephone	Separate poles				365
	1						366
	1						367
	1						368
Each tower	2						369
	1						370
Each tower	2						371
	1						372
Each tower	2						373
	2						374
	2						375
	1						376
	1						377
	1						378
	1						379
Each tower	2						380
	2						381
	2						382
	2						383
	1						384
	2						385
	1						386
	1						387
	1						388
	1						389
	1						390
	1						391
	1						392
	1						393
	1						394
	1						395
	1						396
Each pole	1	None					397
Each pole	1	None					398
Each pole	1	Metallic No. 6 c.c.	Under 63,000-volt circuit				399
Each pole	1	Metallic No. 6 c.c.	Under 63,000-volt circuit				400
Each pole	1	Metallic No. 6 c.c.	Under 63,000-volt circuit				401
Each pole	1	Metallic No. 6 c.c.	Under 63,000-volt circuit				402
Each pole	1	Metallic No. 6 c.c.	Under 63,000-volt circuit				403
Each pole	1	None					404
Each pole	1	None					405
Each pole	1	None					406
Each pole	1	None					407
Each pole	1	None					408
Each pole	1	None					409
Each pole	1	Metallic No. 5 c.c.	Under 63,000-volt circuit				410
Each pole	1	None					411
Each pole	1	Metallic No. 6 c.c.	Under 63,000-volt circuit				412
Each pole	1	None					413
None		Telephone	On power line				414
None		Telephone	On power line				415
None		Telephone	On power line	Yes	Yes	Yes	416
		Telephone	On power line	Yes	Yes	Yes	417
Every 2nd pole	2	Telephone	On power line	Yes	No		418
Every 2nd pole	1	Telephone	On power line	Yes	No		419
Every 1,500 ft	2	Telephone	On power line	Yes	Yes	Yes	420
Every 600 ft	1	Telephone	On power line	Yes	None	None	421
Every 600 ft	1	Telephone	On power line	Yes	None	None	422
Every 600 ft	1	Telephone	On power line	Yes	None	None	423
Every 600 ft	1	Telephone	On power line	Yes	None	None	424
Every 600 ft	1	Telephone	On power line	Yes	None	None	425
		Telephone	On power line	Yes	None	None	426
Every 700 ft	2	Telephone	On power line	Yes	None	None	427
		Telephone	On power line	Yes	None	None	428
Every 700 ft	1	Telephone	On power line	Yes	None	None	429
Every 700 ft	1	Telephone	On power line	Yes	None	None	430
Every 700 ft	1	Telephone	On power line	Yes	None	None	431
Every 700 ft	1	Telephone	On power line	Yes	None	None	432
Every 700 ft	1	Telephone	On power line	Yes	None	None	433
Every 700 ft	1	Telephone	On power line	Yes	None	None	434
Every 700 ft	1	Telephone	On power line	Yes	None	None	435
Every 700 ft	1	Telephone	On power line	Yes	None	None	436
Every 600 ft	1	Telephone	On power line	Yes	None	None	437
Every 600 ft	1	Telephone	On power line	Yes	None	None	438
Every 600 ft	1	Telephone	On power line	Yes	None	None	439
Every 700 ft	1	Telephone	On power line	Yes	None	None	440
		Telephone	On power poles	Yes	None	None	441
		Telephone	On power poles	Yes	None	None	442
		Telephone	On power poles	Yes	None	None	443
		Telephone	On power poles	Yes	None	None	444
		Telephone	On power poles	Yes	None	None	445
		Telephone	On power poles	Yes	None	None	446
		Telephone	On power poles	Yes	None	None	447
		Telephone	On power poles	Yes	None	None	448
		Telephone	On power poles	Yes	None	None	449
		Telephone	On power poles	Yes	None	None	450
Every 800 ft	2	Telephone	On power poles	Yes	None	None	451
Every 800 ft	2	Telephone	On power poles	Yes	None	None	452
Every 800 ft	2	Telephone	On power poles	Yes	None	None	453
Every 800 ft	2	Telephone	On power poles	Yes	None	None	454
Every 700 ft	1	Telephone	On power poles	Yes	None	None	455
Every 880 ft	2	Telephone	Separate poles	Yes	None	None	456
Every 680 ft	2	Telephone	Separate poles	Yes	None	None	457
Every tower	2	Telephone	Separate poles	Yes		Yes	458
Every tower	2	Telephone	On power poles	Yes	None	None	459
Every tower	2	Telephone	Separate poles	Yes			460
Every tower	2	Telephone	On power towers	Yes	None		461
Every 2nd pole	1	Telephone	On power poles	Yes	None	None	462
Every tower	2	Telephone	Separate poles	Yes	None	None	463
Every 2nd tower	2	Telephone	On power poles	Yes	None	None	464
Every 2nd tower	2	Telephone	On power poles	Yes	None	None	465
Every 2nd tower	2	Telephone	On power poles	Yes	None	None	466
Every 2nd tower	2	Telephone	On power poles	Yes	None	None	467
Every tower	2	Telephone	None	Yes	None	None	468
	0	Bell telephone				Yes	469
None	None	None	None	Air break	Oil break		470
None	None	None	None	Air break	Oil break		471
None	None	None	None	Air break	Oil break		472
None	None	Telephone	On power poles	Burke	Oil		473
None	None	Telephone	On power poles	Burke	Oil		474
None	None	Telephone	On power poles	Burke	Oil		475
None	None	Telephone	On power poles	Burke	Oil		476
None	None	Telephone	On power poles	Burke	Oil		477
None	None	Telephone	On power poles	Burke	Oil		478
None	None	Telephone	On power poles	Burke	Oil		479

465	Holter—East Helena	1915	212,300	.....		17,000	.....	.....	100,000	3	
466	East Helena—Josephine	1915	213,300	.....		17,000	.....	.....	100,000	3	
467	Volta—Zinc Plant	1915	212,300	.....		25,000	35,000	.....	100,000	3	
468	Electric Furnace Line	1918	212,300	.....		17,000	.....	.....	100,000	3	
	Missoula Public Service Co.										
469	Missoula—Hamilton	1910	K1,000	.....		.....	3,000	.....	L40,000	3	
	Trinidad Elec. Tr. Ry. & Gas Co.										
470	Trinidad—Raton	1914	M1,500	M3,000		.....	.....	.....	44,000	3	
471	Raton—Sugarite	1914	M1,500	M3,000		.....	.....	.....	44,000	3	
472	Raton—Koehler	1914	M1,500	M3,000		.....	.....	.....	44,000	3	
	Public Service Co. of Colo.										
473	Lafayette—Longmont	1906—07	56,000	132,000		.....	.....	.....	44,000	3	
474	Longmont—Loveland	1906—07	56,000	132,000		.....	.....	.....	44,000	3	
475	Loveland—Ft. Collins	1906—07	56,000	132,000		.....	.....	.....	44,000	3	
476	Ft. Collins—Windsor	1906—07	56,000	132,000		.....	.....	.....	44,000	3	
477	Windsor—Greeley	1906—07	56,000	132,000		.....	.....	.....	44,000	3	
478	Greeley—Ft. Lupton	1910	56,000	132,000		.....	.....	.....	44,000	3	
479	Ft. Lupton—Puritan	1910	56,000	132,000		.....	.....	.....	44,000	3	
480	Puritan—Lafayette	1910	56,000	132,000		.....	.....	.....	44,000	3	
	Western Colorado Power Co.										
481	Montrose—Ouray	1922	780	.....		1,200	1,200	1,200	44,000	3	
482	Silverton—Tacoma	1905	4,500	.....		4,500	4,500	4,500	44,000	3	
483	Silverton—Neeletown—Tacoma	1905	4,500	.....		4,500	4,500	4,500	44,000	3	
484	Tacoma—Durango	1910	1,000	.....		1,500	1,500	1,500	44,000	3	
	Colorado Power Co.										
485	Boulder—Denver	....	13,000	.....		5,000	13,000	.....	90,000	3	
486	Denver—Georgetown	....	1,000	.....		10,000	14,000	.....	90,000	3	
487	Georgetown—Leadville	....	1,925	.....		10,000	14,000	.....	90,000	3	
488	Leadville—Shoshone	....	14,000	.....		10,000	14,000	.....	90,000	3	
489	Boulder—Moffat Tunnel	....	.....	.....		.....	3,000	.....	44,000	3	
	Arizona Power Company										
490	Irving—Childs	1915	1,650	.....		3,000	.....	.....	44,000	3	
491	Childs—Poland Jct.	1908	1,650	.....		3,000	.....	.....	44,000	3	
492	Childs—Tapco	1910	1,650	.....		3,000	.....	.....	44,000	3	
493	Tapco—Poland Jct	1908	1,650	.....		3,000	.....	.....	44,000	3	
494	Poland Jct.—Prescott	1909	1,650	.....		3,000	.....	.....	44,000	3	
	Phelps Dodge Corp.										
495	Bisbee—Douglas	1920	13,700	.....		5,000	10,000	.....	44,000	3	
	Calumet & Arizona Mng. Co.										
496	Douglas—Lowell	1917	6,500	.....		3,000	5,000	.....	44,000	3	
	Desert Power & Water Co.										
497	Kingman—Oatman	....	4,300	4,300		1,800	3,500	.....	45,000	3	
498	Kingman—Chloride	....	4,300	4,300		300	3,500	.....	45,000	3	
	Pacific States—(See end of tabulation for additional lines in this section)										
	Portland Elect. Pwr. Co.										
499	Sta. G—Sta. M	1924	19,700	.....		.....	.....	.....	57,100	3	
500	Sta. M—Sta. L	1911—12—13	27,500	.....		.....	.....	.....	57,100	3	
501	Sta. G—Knott Sub	1906	11,800	.....		.....	.....	.....	57,100	3	
502	Sta. O—Col. & Northern Sub	1910—1920	17,600	.....		.....	.....	.....	57,100	3	
503	Sta. O—Lents Sub	1922	17,600	.....		.....	.....	.....	57,100	3	
504	Sta. M—Sta. H (Salem)	1914—17	10,200	.....		.....	.....	.....	57,100	3	
505	Beaver Creek Sub.—Sta. B	1917	5,880	.....		.....	.....	.....	57,100	3	
506	Sellwood Sub—Green Point	1923	.....	.....		.....	.....	.....	57,100	3	
507	Sta. P—Sta. G	1923	32,100	.....		.....	.....	.....	57,100	3	
508	Sellwood Sub.—Beaverton	1911	.....	.....		.....	.....	.....	57,100	3	
	California—Oregon Pwr. Co.										
509	Copco—Delta	1917	37,460	70,560		11,000	14,000	11,000	60,000	3	
510	Prospect—Gold Ray	1911	37,460	70,560		7,500	10,000	7,500	60,000	3	
511	Castella—Trinity Center	1915	37,460	70,560		6,000	7,000	6,000	60,000	3	
512	Prospect—Springfield	1922	37,460	70,560		8,000	10,000	20,000	60,000	3	
513	Line 12—Roseburg	1923—24	37,460	70,560		.....	.....	.....	60,000	3	
	Pacific Power & Lt. Co.										
514	Naches—Pasco	1908	18,300	.....		.....	.....	.....	66,000	3	
515	Naches—Yakima	1923	18,300	.....		.....	.....	.....	66,000	3	
516	Yakima—Priest Rapids	1911	18,300	.....		.....	.....	.....	66,000	3	
517	Priest Rapids—Pasco	1911	18,300	.....		.....	.....	.....	66,000	3	
518	Lind—Pasco	1917	18,300	.....		.....	.....	.....	66,000	3	
519	Tucannon—Pasco	1914	18,300	.....		.....	.....	.....	66,000	3	
520	Pendleton—Pasco	1923	18,300	.....		.....	.....	.....	66,000	3	
521	The Dalles—Hood River	1911	9,825	.....		.....	.....	.....	66,000	3	
522	Beverly—Priest Rapids	1911	18,300	.....		.....	.....	.....	U66,000	3	
	Southern California Ed. Co.										
523	Big Creek—Laguna Bell	1913 and 1923	V225,000	.....		.....	.....	.....	220,000	3	5
524	Kern River No. 3—Vestal	1920	35,000	.....		.....	.....	.....	66,000	3	50 or 6
525	Kern River No. 4—L. A. No. 3	1907—1914	25,000	.....		.....	.....	.....	66,000	3	5
526	L. A. No. 3—Colton	1911	.....	.....		.....	.....	.....	66,000	3	5
527	Newark—Long Beach	1911	.....	.....		.....	.....	.....	66,000	5	5
	Los Angeles Bur. Lt. & Pwr.										
528	San Francisquite—Los Angeles	1916—17	89,356	119,656		89,565	99,200	120,156	110,000	3	5
	San Diego Consol. G. & El. Co.										
529	San Diego—Capistrano	1916—17—18	Y6,100	.....		6,100	.....	10,000	66,000	3	6
530	Del Mar—Escondido	1923	Z10,000	.....		10,000	.....	15,000	66,000	3	6
531	Escondido—Rincon	1924	Z10,000	.....		10,000	.....	15,000	88,000	3	6
	Pacific Gas & Elec. Co.										
532	Pit River—Round Mountain	1921	95,000	.....		158,000	198,000	.....	110,000, 220,000	3	6
533	Round Mountain—Cottonwood	1921	.....	.....		254,000	317,000	.....	110,000, 220,000	3	6
534	Cottonwood—Vaca Dixon	1921	.....	.....		254,000	317,000	.....	110,000, 220,000	3	6
535	Drum—Wise—Newark	1916—1919	74,750	.....		42,600	53,200	.....	110,000	3	6
536	Wise Jct.—Vaca Dixon	1914	74,750	.....		21,300	26,600	.....	110,000	3	6
537	Vaca Dixon—Cordelia	1922	.....	.....		21,300	26,600	.....	110,000	3	6
538	Vace Dixon—Claremont	1922	.....	.....		53,600	79,400	.....	110,000	3	6
539	Stanislaus—San Francisco	1909	43,375	.....		33,375	40,000	.....	104,000	3	6
540	Spring Gap—Stanislaus	1921	41,500	.....		20,200	25,250	.....	104,000	3	6
541	Cordelia—Petaluma	1909 or prior	.....	.....		4,590	5,750	.....	60,000	3	6
542	Petaluma—Santa Rosa	1901	.....	.....		4,590	5,750	.....	60,000	3	6
543	Santa Rosa—Mirabel Pk	1904 and 1922	.....	.....		2,880	3,620	.....	60,000	3	6
544	South—Inskip	Prior to 1913	10,000	.....		7,310	9,210	.....	60,000	3	6
545	Inskip—Coleman	Prior to 1913	21,000	.....		7,310	9,210	.....	60,000	3	6
546	Coleman—Cottonwood	1915—19	15,000	.....		5,800	7,220	.....	60,000	3	6
547	South—Volta	Prior to 1913	10,250	.....		5,800	7,220	.....	60,000	3	6
548	Hetch-Hetchy—Modesto	Prior to '16, '21, '22	.....	.....		2,880	3,620	.....	60,000	3	6
549	Cottonwood—Hamilton Jct	Prior to 1913, 1920	.....	.....		9,210	11,500	.....	60,000	3	6
550	Hamilton Jct.—Maxwell Jct	Prior to 1913	.....	.....		9,210	11,500	.....	60,000	3	6
551	Maxwell Jct.—Colusa Corners	Prior to 1913	.....	.....		9,210	11,500	.....	60,000	3	6
552	Hamilton—Colusa Corners	Prior to 1913 and 1920	.....	.....		9,210	11,500	.....	60,000	3	6
553	Coleman—Hamilton	1915—1919	.....	.....		9,210	11,500	.....	60,000	3	6
554	Palo Cedro—Redding	Prior to 1913	.....	.....		2,880	3,620	.....	60,000	3	6
555	Kilarc—Palo Cedro	Prior to '13, '15, '19	4,500	.....		2,880	3,620	.....	60,000	3	6
556	Kennet—Redding	Prior 1913 & 1921	.....	.....		2,880	3,620	.....	60,000	3	6
557	Colgate—De Sabla	1903	37,975	.....		14,650	18,300	.....	60,000	3	6
558	Lime Saddle—Lime Sad. Jct	1906	3,000	.....		2,880	3,620	.....	60,000	3	6
559	Centerville—Durham Jct	1904	14,000	.....		9,210	11,500	.....	60,000	3	6
560	Smartsville—Marysville	1906 and 1917	.....	.....		2,880	3,620	.....	60,000	3	6
561	Heyman Jct.—Meridan	1909—1912	.....	.....		2,880	3,620	.....	60,000	3	6
562	Durham Jct.—Marysville	1906	.....	.....		9,210	11,500	.....	60,000	3	6
563	Cordelia—Marin	1912—1915	.....	.....		7,310	9,210	.....	60,000	3	6
564	Petaluma—Alto	1908	.....	.....		4,590	5,750	.....	60,000	3	6
565	Colgate—Cordelia No. 1	1900	15,575	.....		9,210	11,500	.....	60,000	3	6
566	Colgate—Cordelia No. 2	1900 and 1915	15,575	.....		7,310	9,210	.....	60,000	3	6
567	Alta—Davis	1907—1909—1912	54,750	.....		3,640	4,560	.....	60,000	3	6
568	Colgate—Sacramento	1900	10,575	.....		7,310	9,210	.....	60,000	3	6
569	Alta—Grass Valley	1912	2,000	.....		3,640	4,560	.....	60,000	3	6
570	Grass Valley—Colgate	1900	47,700	.....		9,210	11,500	.....	60,000	3	6
571	Stockton—New Hope	1909—1919	.....	.....		2,880	3,620	.....	60,000	3	6
572	Electra—Herdlyn	1900	20,000	.....		14,650	18,300	.....	60,000	3	6
573	Herdlyn—South Tower	Prior 1911 and 1919	.....	.....		11,600	14,500	.....	60,000	3	6
574	Herdlyn—Newark	1900—1920	.....	.....		14,650	18,300	.....	60,000	3	6
575	Mt. View—Davenport	1907	.....	.....		9,210	11,500	.....	60,000	3	6
576	Alviso—San Jose	1909—1912	.....	.....		23,200	29,000	.....	60,000	3	6
577	Manteco—Modesto	1920	.....	.....		7,310	9,210	.....	60,000	3	6
578	Modesto—Patterson	1920	.....	.....		5,800	7,220	.....	60,000	3	6
579	Patterson—Newman	1909—1920	.....	.....		4,590	5,750	.....	60,000	3	6
580	Newark—New Martin	1900—1922	91,000	.....		34,700	43,300	.....	60,000	3	6
581	Drum—Deer Creek	1912	43,000	.....		9,210	11,500	.....	60,000	3	6
582	Port Marion—Salinas	Prior 1916, 1920	.....	.....		11,600	14,400	.....	60,000	3	6
583	Keswick—Weaverville	1915—1919	.....	.....		2,880	3,620	.....	60,000	3	6
584	Delta—Kennett	1915—1919	.....	.....		9,210	11,500	.....	60,000	3	6
585	South Tower—Richmond	1909	.....	.....		5,800	7,220	.....	60,000	3	6
586	Alto—Drum	1913	39,500	.....		5,800	7,220	.....	60,000	3	6
587	South Tower—Ridge	1908	.....	.....		5,800	7,200	.....	60,000	3	6
588	Claremont—Newark	1923	33,500	.....		29,300	36,600	.....	60,000	3	6
589	Cordelia—North Tower	1900—1922	.....	.....		18,420	23,000	.....	60,000	3	6
590	Volta—Inskip	Prior 1913	12,250	.....		9,210	11,500	.....	60,000	3	6
591	Volta—Palo Cedro	Prior 1913	6,250	.....		9,210	11,500	.....	60,000	3	6
592	Redding—Cottonwood	Prior 1913, 1921	.....	.....		4,590	5,750	.....	60,000	3	6
593	Marysville—Nicolaus	1907	.....	.....		7,310	9,210	.....	60,000	3	6
594	Inskip—Chico	Prior 1913	6,000	.....		5,800	7,220	.....	60,000	3	6
595	Kennett—Palo Cedro	Prior 1913	.....	.....		9,210	11,500	.....	60,000	3	6
596	Newark—San Francisco	1900—1922	90,000	.....		29,300	36,600	.....	60,000	3	6
597	Spaulding—Drum	1917—1923	42,250	.....		5,800	7,220	.....	60,000	3	6
598	Summit—Spaulding	1923	42,250	.....		5,800	7,220	.....	60,000	3	6
	San Joaquin Lt. & Pwr. Corp.										
599	Livingston—Newman	1921	.....	.....		.....	.....	.....	60,000	3	6
600	Midway—McKittrick	1923	.....	.....		.....	.....	.....	110,000	3	6
601	McKittrick—Santa Maria	1923	.....	.....		.....	.....	.....	160,000	3	6
602	Santa Maria—Henrietta	1912—1913	.....	.....		.....	.....	.....	60,000	3	6
603	Kerckhoff—Merced	1920	.....	.....		.....	.....	.....	110,000	3	6
604	Kearny—San Joaquin	1921	.....	.....		.....	.....	.....	60,000	3	6
605	Livingston—Merced	1921	.....	.....		.....	.....	.....	60,000	3	6
606	Bakersfield—Famosa	1911	.....	.....		.....	.....	.....	60,000	3	6
607	Tule—Shathmore	1914	.....	.....		.....	.....	.....	60,000	3	6
608	Bakersfield—Henrietta	1911	.....	.....		.....	.....	.....	60,000	3	6
609	Henrietta—Copper Mine	1911	.....	.....		.....	.....	.....	60,000	3	6

1,000	Cu.		126		25	29	33		440	500					Locke		2 sus.		Locke
5,000	Cu.		126		30	35	40		500	600				6 sus.	Thomas		6 sus.		Thom
	Cu.		48		25	30	28		140	150	2			3	Ohio Brass				
	Cu.		60		20—30	26	30	8	175—250	800				1	Various			4	West
	Iron.		60		20—30	26	30	8	175—250	800				1	Various			4	West
	Cu.—Iron.		60		20—30	26	30	8	175—250	800				1	Various			4	West
2/0	Cu.		48	N	N	N	N		125	150	Std.	Std.		Pin.	Ohio Brass, Thomas, West.			3	Hewl
2/0	Cu.		48	N	N	N	N		125	150	Std.	Std.		Pin.	Ohio Brass, Thomas, West.			3	Hewl
1/0	Cu.		48	N	N	N	N		125	150	Std.	Std.		Pin.	Ohio Brass, Thomas, West.			3	Hewl
	Cu.		48	N	N	N	N		125	150	Std.	Std.		Pin.	Ohio Brass, Thomas, West.			3	Hewl
	Cu.		48	N	N	N	N		125	150	Std.	Std.		Pin.	Ohio Brass, Thomas, West.			3	Hewl
1/0	Cu.		48	N	N	N	N		125	150	Std.	Std.		Pin.	Ohio Brass, Thomas, West.			3	Hewl
1/0	Cu.		48	N	N	N	N		125	150	Std.	Std.		Pin.	Ohio Brass, Thomas, West.			3	Hewl
1/0	Cu.		48	N	N	N	N		125	150	Std.	Std.		Pin.	Ohio Brass, Thomas, West.			3	Hewl
	Cu.		72		30	30	30		300	814	4.75	500		1 pin.	Ohio Brass				Ohio
	Al.		60		30	30	30	5	200 av.	900	2.5			1 pin.	Thomas				Vario
	Al.		60		30	30	30	5	200 av.	1,100	2.5			1 pin.	Thomas				Vario
	Cu.		60		25	25	25	5	175 av.	300	1.5			1 pin.	Thomas				Vario
	Str. Cu.		120		30	30	35		720	2,700	18	1,250		5 disc.	Hewlett		6 disc.		Hewl
	Str. Cu.		120		30	30	35		700	2,700	18	1,250		5 disc.	Hewlett		6 disc.		Hewl
	Str. Cu.		120		30	30	35		692	2,700	18	1,250		5 disc.	Hewlett		6 disc.		Hewl
	Str. Cu.		120		30	30	35		875	2,700	18	1,250		5 disc.	Hewlett		6 disc.		Hewl
	Str. Cu.		52		26	30	35	5	150	289	12	65		1 pin.	Locke		2 disc.		Hewl
	Cu.		90		20	25	28	10	500	1,500				3	Thomas, Jeffery-Dewitt			4	Thon
	Cu.		120		20	25	28	10	500	1,500	P5.5	600		3	Thomas, Jeffery-Dewitt			4	Thon
	Cu.		90		20	25	28	10	500	1,500	P5.5	600		3 and 4	Thomas			4	Thon
	Cu.		90—120		20	25	28	10	500	1,500				3 and 4	Thomas			4	Thon
	Cu.		120		20	25	28	10	500	1,500				3 and 4	Thomas			4	Thon
	Cu.		60		2	24	31	7						1 pin.	Ohio Brass, Locke			5	Lock
	Cu.		87		27	40	35	None	600	1,250	15	5,000		3 sus.	Locke		4 sus.		Lock
	Solid Cu.		52		26	30	39	8—10	180	298	1.5	800		1 pin.	Ohio Brass, Thomas			3	Lock
	Solid Cu.		52		26	30	39	8—10	200	275	2.0	800		1 pin.	Ohio Brass, Thomas			3	Lock
0,000	Cu.		120		25	30 min.	34 min.		600	622				4 sus.	Ohio Brass		5 sus.		Ohio
,000	Cu.		72		25	30 min.	34 min.		500	560				3 sus.	Ohio Brass		4 sus.		Ohio
5,570	Cu.		72		35	30 min.	34 min.	6—10	138	200				1 pin.	Ohio Brass		4 sus.		Ohio
	Al.—Cu.		67—72		30—35	30 min.	34 min.	6—10	125	300				1 pin.	Ohio Brass		4 sus.		Ohio
	Cu.		72		32—25	30 min.	34 min.	6—10	150—500	200—560				4 sus.	Ohio Brass		5 sus.		Ohio
60	Al., Al., Cu., Cu., Cu.		60—72		30	30 min.	34 min.	6—10	150	200				1 pin.	Ohio Brass		4 sus.		Ohio
	Cu.		60—72		32	30 min.	34 min.	6—10	150	200				1 pin.	Ohio Brass		4 sus.		Ohio
	Cu.		72		45	30 min.	34 min.	6—10	100	300				1 pin.	Ohio Brass		4 sus.		Ohio
0,000	Cu.		120		25	30 min.	34 min.	6—10	700	1,602				5 sus.	Ohio Brass		9 sus.		Ohio
	Cu., Galv. steel., Cu.		72		45	30 min.	34 min.	6—10	150	200				1 pin.	Ohio Brass		4 sus.		Ohio
	Cu.		72		25	30	34	8	150	1,200	1.7			Pin.	Locke, No. 351, Ohio Brass,		No. 12,855	5	Lock
	Al.		72		28	28		8	150	600	2.6			Pin.	Locke, No. 351.			4	Lock
	Cu.		72		30	33		8	150	300	1.7			Pin.	Locke.			5	Lock
	Cu.		126		31.75	31.75	47.33	8	500	1,800	8.6	1,450		4 sus.	Ohio Brass, No. 25,622.			5	Ohio
	Cu.		60		23.67	24	32	4	300		5			Pin.	Ohio Brass, No. 12,855.				
1/0	Cu.		84	32 av.		23 min.	34 min.	8	250	500	2.5	1,050		Pin.	Thomas, Locke.		5 disc.		Thor
1/0	Cu.		84	32 av.		23 min.	34 min.	8	250	500	2.5	1,050		Pin.	Thomas, Locke.		5 disc.		Thor
2/0	Cu.		84	32 av.		23 min.	34 min.	8	250	500	2.5	1,050		32 mi., pin. 12 mi.—4 disc.	Thomas		5 disc.		Thor
4/0	Al.		84	32 av.		23 min.	34 min.	8	250	500	2.5	500		Pin.	Thomas		5 disc.		Thor
1/0	Cu.		120	32 av.		23 min.	34 min.	8	250	500	2.5	1,050		5 disc.	Locke.		7 disc.		Lock
	Cu.—Cu.—Iron.		84	32 av.		23 min.	34 min.	8	250	500	2.5			45 mi., pin. 49 mi.—4 disc.	Thomas, Locke		5 disc.		Thor
1/0	Cu.		84	32 av.		23 min.	34 min.	8	250	500	2.5	1,050		Pin.	Locke.		5 disc.		Lock
	C. C. Steel Cu. Cu.		84—84—120	32 av.										21 mi., pin. 26 mi.—4 disc. 7 mi.—5 disc.	Thomas		47 mi.—5 disc. 7 mi.—7 disc.		Thor
	Cu.		84	32 av.										Pin.	Thomas		5 disc.		Thou
6,600	A. C. S. R.		204—264		25—30	30	34	12	660—1250	2,871		W8,000 W12,000		Std. 10" c. & p.	Locke, O. Br., Lapp, Westgh. St		l., & hi. str. c. & p.		Lock
4/0	Cu.		72		25—30	30	34	8						Std. 10" c. & p.	Locke, O. Br., Lapp, Westgh. St		l., & hi. str. c. & p.		Lock
4/0	Cu.		84×108 Rt. Tri.		25—30	30	34	8						Std. 10" c. & p.	Locke, O. Br., Lapp, Westgh. St		l., & hi. str. c. & p.		Lock
4/0	Cu.		96		25—30	30	34	8						Std. 10" c. & p.	Locke, O. Br., Lapp, Westgh. St		l., & hi. str. c. & p.		Lock
4/0	Cu.		96		25—30	30	34	8						Std. 10" c. & p.	Locke, O. Br., Lapp, Westgh. St		l., & hi. str. c. & p.		Lock
0,000	Cu.		X		X	30 min.	34 min.		650	2,600	20 at 80° F.	3,500		7 sus.	Ohio Brass, No. 25,620.		8 sus.		Ohio
	Bare Str. Cu.		80		30	30	34	8	440	3,069	8.1	775		6	Locke.			7	Lock
1/0	Bare Str. Cu.		80		35	35	43	8	450	2,870	7.3	1,150		5	Locke.			6	Lock
1/0	Bare Str. Cu.		96		35	35	39	8	450	1,590	7.3	1,150		6	Locke.			7	Lock
8,000	Al.		228 horiz.		42.5	42.5	42.5		700—500	1,712	12.5	3,300		3—13in.disc. 10—10in.disc.	Ohio Brass, Locke.		10—10 in. disc. 2—13 in. disc.		Ohio
8,000	Al.		180 Vert.		42.0	42.0	42.0		500	795	14.0	3,400		10—10in.disc. 3—13in.disc.	Ohio Brass, Locke.		10—10 in. disc 2—13 in. disc		Ohio
8,000	Cu.		180 Vert.		32.0	32.0	34.0		800	1,645	22.0	5,600		10—10in.disc. 3—13in.disc.	Ohio Brass, Locke.		10—10 in. disc. 2—13 in. disc.		Ohio
3/0	Cu.		120 Vert.		39.0	39.0	39.0	15	800	1,672	22.0	1,990		7—10in.disc.	Ohio Brass		7—10 in. disc.		Ohio
3/0	Cu.		120 Vert.		39.0	39.0	39.0	15	800	2,550	22.0	1,900		7—10in.disc.	Ohio Brass		8—10 in. disc.		Ohio
3/0	Cu.		120 Vert.		39.0	39.0	39.0	15	800	1,589	22.0	1,900		7—10in.disc.	Locke		8—10 in. disc.		Lock
0,000	Cu.		120 Vert.		32.0	32.0	34.0	15	800	1,616	22.0	2,750		7—12in.disc.	Locke		8—12 in. disc.		Lock
2/0	Cu.		108 Vert.		44.5	44.5	44.5	15	800	1,600	16.5	2,000		5—10in.disc.	Ohio Brass			5	Ohio
3,000	A. C. S. R.		120 Horiz.		30.0	30.0	34.0	15	600	1,000	10.5	2,750		5—10in.disc.	Ohio Brass		5—10 in. disc.		Ohio
5,000	Al.	84			30.0	30.0	34.0	8	175	500	4.0	1,400		5—10in.disc.	Ohio Brass		6—10 in. disc.		Ohio
5,500	Al.	42			30.0	30.0	34.0	8	175	500	4.0	1,400		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
	Cu.	42			30.0	30.0	34.0	8	175	300	1.2	500		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
1/0	Cu.	42			30.0	30.0	34.0	8	150	400	0.85	1,100		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
1/0	Cu.	42			30.0	30.0	34.0	8	265	500	1.75	1,185		Pin, 66,000kv.	Various		Pin. 66 kv.		Vari
	Cu.	42			30.0	30.0	34.0	8	175	400	1.15	940		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
	Cu.	42			30.0	30.0	34.0	8	265	500	1.75	940		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
	Cu.	84			30.0	30.0	34.0	8	265	500	1.75	500		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
2/0	Cu.	42			30.0	30.0	34.0	8	200	400	1.5	1,493		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
2/0	Cu.	42			30.0	30.0	34.0	8	265	265	1.7	1,490		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
2/0	Cu.	42			30.0	30.0	34.0	8	265	265	1.7	1,490		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
	Cu.	42			30.0	30.0	34.0	8	150	500	0.9	1,001		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
2/0	Cu.	42			30.0	30.0	34.0	8	200	300	1.7	1,490		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
	Al.	42			30.0	30.0	34.0	8	150	300	4.0	500		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
	Cu.	42			30.0	30.0	34.0	8	150	300	0.9	500		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
	Cu.	42			30.0	30.0	34.0	8	200	500	1.65	500		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
0,000	Al.	42			30.0	30.0	34.0	8	150	500	0.9	3,000		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
	Cu.	42			30.0	30.0	34.0	8	175	400	1.2	500		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
1,600	Al.	42			30.0	30.0	34.0	8	175	400	4.0	800		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
	Cu.	84			30.0	30.0	34.0	8	200	400	1.65	500		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
	Cu.	84			30.0	30.0	34.0	8	200	400	1.65	500		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
1,600	Al.	84			30.0	30.0	34.0	8	265	300	4.0	800		Pin, 66,000kv.	Various		Pin, 66 kv.		Vari
1/0	Cu.		120 Vert.		30.0	30.0	34.0	8	800	2,350	22.0	1,200		7—10 in. disc.	Ohio Brass		7—10 in. disc.		Ohio
	Al.	84			30	30	34	8	200	300	1.2	1,100		Pin, 66 kv.	Various		Pin. 66 kv.		Vari
2/0	Cu.	84			30	30	34		265	400	2.5	1,200		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
1/0	Cu.	84			30	30	34		265	400	2.5	1,200		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.	84			30	30	34		175	400	1.2	600		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
0,000	Al.	84			30	30	34	8	264	400	3.0	3,200		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.	84			30	30	34	8	175	500	1.7	600		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
2/0	Cu.	84			30	30	34	8	175	500	1.7	1,500		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.	84			30	30	34	8	265	400	1.7	500		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
4/0	Cu.	84			30	30	34	8	150	300	2.0	2,400		7—10 in. disc.	Ohio Brass		7—10 in. disc.		Ohio
3/0	Cu.	84			30	30	34	8	175	300	2.0	1,900		7—10 in. disc.	Ohio Brass		7—10 in. disc.		Ohio
4/0	Cu.	84			30	30	34	8	175	300	2.0	1,900		7—10 in. disc.	Ohio Brass		7—10 in. disc.		Ohio
1,600	Al.		60 Horiz.		30	30	34	8	265	2,500	4.0	3,100		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
3/0	Cu.		120 Vert.		39	39	39	8	800	900	22.0	1,900		5—10 in. disc.	Ohio Brass		5—10 in. disc.		Ohio
1/0	Cu.				30	30	34	8	265	400	1.7	1,200		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.				30	30	34	8	265	400	1.5	1,000		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.				30	30	34	8	265	400	1.2	800		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
0,000	Cu.		120 Vert.		32	32	34	15	800	1,500	22	2,750		8—10 in. disc.	Ohio Brass		9—10 in. disc.		Ohio
2/0	Cu.	84			30	30	34	8	175	500	1.2	1,490		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
2/0	Al.		66 Vert.		42	42	42	8	800	1,200	1.7	2,000		6—10 in. disc.	Thomas, Locke.		6—10 in. disc.		Thor
	Cu.	42			30	30	34	8	150	300	1.9	500		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
2/0	Cu.	42			30	30	34	8	200	500	1.5	1,500		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.	84			30	30	34	8	265	300	1.7	1,000		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.	84			30	30	34	8	175	300	1.2	1,000		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.		66 Vert.—96 Horiz.		30	30	34	8	175	500	1.2	1,000		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
4/0	Cu.		120 Vert.		32	32	34	8	800	2,115	22.0	2,400		7—10 in. disc. 7—12 in. disc.	Ohio Brass, Locke		8—10 in. disc. 8—12 in. disc.		Ohio
2/0	Cu.		66 Vert.		30	30	34	8	200	400	1.5	1,500		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
2/0	Al.	42			30	30	34	8	175	300	4.0	500		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
2/0	Cu.	42			30	30	34	8	150	300	1.0	1,500		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
1/0	Al.	42			30	30	34	8	200	400	4.0	500		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
1,600	Al.	84			30	30	34	8	200	400	2.0	3,100		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.	42			30	30	34	8	200	400	1.5	1,000		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
2/0	Cu.	42			30	30	34	8	200	400	1.5	1,500		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
0,000	Al.		66 Vert.		30	30	34	8	200	400	4.0	3,200		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.	84			30	30	34	8	175	400	1.2	1,000		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.	84			30	30	34	8	150	300	1.0	1,000		Pin, 66 kv.	Various		Pin, 66 kv.		Vari
	Cu.		90 Horiz.—78 Vert.						352					4				5	
66,800	Al.		120 Horiz.—120 Vert.						580					7				8	
66,800	Al.		120 Horiz.—120 Vert.						580					4				8	
4/0	Al.		84						580					1 pin.				5	
66,800	Al.		120 Horiz.—120 Vert.						580					7				8	
3/0	Cu.		90 Horiz.—78 Vert.						352					4				5	
	Cu.		90 Horiz.—78 Vert.						352					4				5	
3/0	Al.		108						352					1 pin.				5	
1/0	Cu.		84						352					1 pin.				5	
3/0	Al.		108						352					1 pin.				5	
3/0	Al.		108						352					1 pin.				5	

	Locke	None	None		Wood	Wood						
	Thomas	None	None		Wood	Wood		40			None	
					None	None						
4	Westinghouse	None	None		Wood	Wood	Steel	30				
4	Westinghouse	None	None		Wood	Wood	Steel	30				
4	Westinghouse	None	None		Wood	Wood	Steel	30				
3	Hewlett Westinghouse	None	None		Wood	Wood	Steel			10

	34										
	40		None	None		Al. cell	None	None	Steel	Every tower	
						Electro	Electro	Stevensville—Hamilton	Iron		
Steel	30					Electro	Electro		None	None	
Steel	30					Electro	Electro		None	None	
Steel	30					Electro	Electro		None	None	
Steel		10			60—90	Oxide film electro	Oxide film

Every tower	2	Telephone	On power poles	Yes	None	None		468
	0	Bell telephone				Yes		469
None	None	None	None	Air break	Oil break			470
None	None	None	None	Air break	Oil break			471
None	None	None	None	Air break	Oil break			472
None	None	Telephone	On power poles	Burke	Oil			473
None	None	Telephone	On power poles	Burke	Oil			474
None	None	Telephone	On power poles	Burke	Oil			475
None	None	Telephone	On power poles	Burke	Oil			476
None	None	Telephone	On power poles	Burke	Oil			477
None	None	Telephone	On power poles	Burke	Oil			478
None	None	Telephone	On power poles	Burke	Oil			479
None	None	Telephone	On power poles	Burke	Oil			480
Every pole	1	Telephone	On power poles	Air	Oil	Yes		481
None	None	Telephone	On power poles	Air and oil	Air and oil	Yes		482
None	None	Telephone	On power poles	Air and oil	Air and oil	Yes		483
15	1	Telephone	On power poles	Air and oil	Oil	Yes		484
None		Telegraph—Telephone		Oil	Oil			485
None		Telegraph—Telephone		Oil	Oil			486
None		Telegraph—Telephone		Oil	Oil			487
None		Telegraph—Telephone		Oil	Oil			488
None		Telephone		Oil	Oil			489
	None	Telephone	Separate poles, 100 feet away			Yes		490
	None	Telephone	Separate poles, 100 feet away			Yes		491
Every tower	1	Telephone	Separate poles, 100 feet away			Yes		492
Every tower	1	Telephone	Separate poles, 100 feet away			Yes		493
Every tower	1	Telephone	Separate poles, 100 feet away			Yes		494
None	None	Telephone	7 feet below line		Yes			495
Every tower		Bell telephone		Air	Oil	Yes		496
None	None	Telephone	On power poles	Oil and air	Oil	Yes		497
96	1	Telephone	On power poles	Oil and air	Oil	Yes		498
	None			Yes				499
Every 10 towers	1					Yes		500
	None	Telephone	On power poles			Yes		501
	None					Yes		502
	None			Yes		Yes		503
	None	Telephone	On power poles	Yes	Yes			504
	None			Yes		Yes		505
	None			Yes		Yes		506
	None	Carrier current	W. E. Co. power line	Yes		Yes		507
	None			Yes		Yes		508
None	None	Telephone	On power poles			Yes		509
None	None	Telephone	On power poles	Yes		Yes		510
None	None	Telephone	On power poles	Yes		Yes		511
None	None	Telephone	On power poles			Yes		512
None	None	Telephone	On power poles	Yes		Yes		513
		Telephone	On power poles					514
		Telephone	On power poles					515
Every pole	1	Telephone	On power poles					516
		Telephone	On power poles					517
Every pole	1	Telephone	On power poles					518
Every pole	1	Telephone	On power poles					519
		Telephon	On power poles					520
Every pole	1	Telephone	On power poles			Yes		521
		None						522
Each tower	1			Yes				523
Each tower	1			Yes				524
				Yes				525
				Yes				526
				Yes				527
3	1	Telephone	On separate poles	Yes	Yes	Yes		528
None	None	None	None			Yes		529
None	None	None	None			Yes		530
None	None	None	None			Yes		531
		Carrier current			No	Yes A		532
		Carrier current			No			533
2	2	Carrier current		Yes	No			534
		2-wire metallic	On power towers	Yes	No			535
1	1	None	None	Yes	No			536
1	1	None	None	Yes	No			537
1	1	Carrier current		Yes	No			538
		None	None	Yes	No			539
		2-wire metallic	On power poles	Yes	No			540
		2-wire metallic	On power poles	Yes	No			541
		2-wire metallic	On power poles	Yes	No			542
		2-wire metallic	On power poles	Yes	No			543
		2-wire metallic	On power poles	Yes	No			544
		2-wire metallic	On power poles	Yes	No			545
		2-wire metallic	On power poles	Yes	No			546
		2-wire metallic	On power poles	Yes	No			547
1	1	2-wire metallic	On power poles	Yes	No			548
		2-wire metallic	On power poles	Yes	No			549
		2-wire metallic	On power poles	Yes	No			550
		2-wire metallic	On power poles	Yes	No			551
		2-wire metallic	On power poles	Yes	No			552
		2-wire metallic	On power poles	Yes	No			553
		2-wire metallic	On power poles	Yes	No			554
		2-wire metallic	On power poles		No	Yes		555
		2-wire metallic	On power poles	Yes	No			556
		2-wire metallic	On power poles	Yes	No			557
		2-wire metallic	On power poles		No	Yes		558
		2-wire metallic	On power poles	Yes	No			559
		2-wire metallic	On power poles	Yes	No			560
2	2	2-wire metallic	On power poles	Yes	No			561
		2-wire metallic	On power poles	Yes	No			562
		None		Yes	No			563
		2-wire metallic	On power poles	Yes				564
2	2	2-wire metallic	On power poles	Yes				565
2	2	2-wire metallic	On power poles	Yes				566
2	2	2-wire metallic	On power poles	Yes				567
		2-wire metallic	On power poles	Yes				568
		2-wire metallic	On power poles	Yes				569
		2-wire metallic	On power poles	Yes				570
		2-wire metallic	On power poles	Yes				571
		2-wire metallic	On power poles			Yes		572
2	2	2-wire metallic	On power poles	Yes				573
		2-wire metallic	On power poles	Yes				574
		2-wire metallic	On power poles	Yes				575
2	2	2-wire metallic	On power poles	Yes				576
		2-wire metallic	On power poles	Yes				577
		2-wire metallic	On power poles	Yes				578
		2-wire metallic	On power poles	Yes				579
		None		Yes				580
2		2-wire metallic	On power poles			Yes		581
		2-wire metallic	On power poles	Yes				582
	2	2-wire metallic	On power poles	Yes				583
		2-wire metallic	On power poles	Yes				584
2		2-wire metallic	On power poles	Yes				585
		2-wire metallic	On power poles	Yes				586
2	2	2-wire metallic	On power poles	Yes				587
1	1	2-wire metallic	On power poles	Yes				588
2	2	2-wire metallic	On power poles	Yes				589
		2-wire metallic	On power poles	Yes				590
		2-wire metallic	On power poles	Yes				591
		2-wire metallic	On power poles	Yes				592
		2-wire metallic	On power poles	Yes				593
		2-wire metallic	On power poles	Yes				594
1	1	2-wire metallic	On power poles	Yes				595
		2-wire metallic	On power poles	Yes				596
		2-wire metallic	On power poles	Yes				597
		2-wire metallic	On power poles	Yes				598
		Telephone						599
								600
		Telephone						601
								602
		Telephone						603
		Telephone						604
		Telephone						605
		Telephone						606
		Telephone						607
		Telephone						608

595	Kennett—Palo Cedro	Prior 1913				9,210	11,500		60,0		3	
596	Newark—San Francisco	1900—1922	90,000			29,300	36,600		60,0		3	
597	Spaulding—Drum	1917—1923	42,250			5,800	7,220		60,00		3	
598	Summit—Spaulding	1923	42,250			5,800	7,220		60,000		3	
	San Joaquin Lt. & Pwr. Corp.											
599	Livingston—Newman	1921							60,000		3	
600	Midway—McKittrick	1923							110,000		3	
601	McKittrick—Santa Maria	1923							60,000		3	
602	Santa Maria—Henrietta	1912—1913							60,000		3	
603	Kerckhoff—Merced	1920							110,000		3	
604	Kearny—San Joaquin	1921							60,000		3	
605	Livingston—Merced	1921							60,000		3	
606	Bakersfield—Famosa	1911							60,000		3	
607	Tule—Shathmore	1914							60,000		3	
608	Bakersfield—Henrietta	1911							60,000		3	
609	Henrietta—Copper Mine	1911							60,000		3	
610	Crane Valley—Copper Mine	1896,1906, 1914,1919							60,000		3	
611	Kerckhoff—Midway	1921							110,000		3	
612	Canyon—Bakersfield	1913							60,000		3	
613	Famosa—Semitropic	1921							60,000		3	
614	Livingston—Turlock	1924							60,000		3	
615	Kearny—Reedley	1921							60,000		3	
616	Famosa—Copper Mine	1912—1913							60,000		3	
617	Copper Mine—Madera	1919							60,000		3	
618	Madera—Mendota	1911							60,000		3	
619	Los Banos—Livingston	1921							60,000		3	
620	Mendota—Coalinga	1922							60,000		3	
621	Henrietta—Corcoran	1917							60,000		3	
622	Henrietta—Kearney	1911							60,000		3	
623	Santa Maria—Los Alamos	1921							60,000		3	
624	Santa Maria—Lompoc	1923							60,000		3	
625	Santa Maria—Better via	1918							60,000		3	
626	Corcoran—Alpaugh	1919							60,000		3	
	Western States Gas & El. Co.											
627	Amer. River—Valley Spr.—Stockt	on 1903	27,000			10,000	15,000		60,000		3	
628	Amer. River—Galt—Stockton	1903—1906	27,000			10,000	15,000		60,000		3	
629	El Dorado—Nigger Hill Jct	1923	24,000			50,000	75,000		60,000		3	
630	Weaverville—Eureka	1906	2,150			2,150	3,500		60,000		3	
	Coast Valleys G. & El. Co.											
631	Salmas—Soledad	1912	Purchase energy.			5,000	6,000		55,000		3	
632	Alisal—Soledad	1920	Purchase energy.			8,000	1,000		55,000		3	
633	Soledad—King City	1913	Purchase energy.			5,000	18,000		55,000		3	
	Middle Atlantic States (*Continued*)											
	Pennsylvania Power & Light Co.											
634	Harwood—Frackville	1922	51,900				25,000		66,000		3	
635	Harwood—Shenandoah	1923	51,900				38,000		66,000		3	
636	Harwood—Wilkes-Barre	1922	51,900				62,000		66,000		3	
637	Harwood—Hauto	1918	51,900—100,000				144,000		66,000		3	
638	Hauto—Frackville	1921	100,000				24,000		66,000		3	
639	Hauto—Shenandoah	1924	100,000				35,000		66,000		3	
640	Hauto—Siegfried	1923	100,000				28,600		66,000		3	
641	Shenandoah—Exchange	1919					39,000		66,000		3	
642	Shenandoah—66 Kv. Tap	1919							66,000		3	
643	Oneido Colliery Tap	1922							66,000		3	
644	Shenandoah Boro. Wr. Wks. Tap	1919							66,000		3	
645	Mahonoy City Tap	1922							66,000		3	
646	Lawrence Col. Tap	1922							66,000		3	
647	Eastern Penn. Ry. Tap	1923							66,000		3	
648	Candlemas Tap	1924							66,000		3	
649	Frackville Exchange	1922					35,000		66,000		3	
650	Frackville—Shamokin	1922					27,500		66,000		3	
651	Girardville—66 Kv Tap	1922							66,000		3	
652	Packe No. 2	1921							66,000		3	
653	Centralia—66 Kv. Tap	1919							66,000		3	
654	Mid Valley No. 1 Tap	1923							66,000		3	
655	Mid Valley No. 2 Tap	1924							66,000		3	
656	Shamokin—Mt. Carmel Tap	1921							66,000		3	
657	Exchange—Mt. Camel Tap	1921							66,000		3	
658	Enterprise Tap	1922							66,000		3	
659	Exchange—Danville	1923					31,000		66,000		3	
660	Exchange—Sunbury	1919					22,000		66,000		3	
661	Exchange—Hickory Swamp	1922							66,000		3	
662	Shamokin—66 Kv. Tap	1924							66,000		3	
663	Shipman Koal Co. Tap	1923							66,000		3	
664	Buck Ridge Coal Co. Tap	1923							66,000		3	
665	Sunbury—Milton	1924	3,100				37,000		66,000		3	
666	Milton—Williamsport	1924	3,100—24,400				25,300		66,000		3	
667	Montgomery Tap	1924							66,000		3	
668	Williamsport—Lock Haven	1924	24,400—5,500				19,500		66,000		3	
669	St. Johns—Freeland	1923							66,000		3	
670	Wilkes-Barre—Plymouth	1924							66,000		3	
671	Phoenix—66 Kv. Tap	1922					24,000		66,000		3	
672	Cherry Hill—66 Kv. Tap	1924							66,000		3	
673	Siegfried—Egypt	1923							66,000		3	
674	Allentown—Siegfried	1920	43,000				126,000		66,000		3	
675	Allentown—Freemansburg	1924	43,000				71,500		66,000		3	
676	Hauto—Siegfried	1912					53,700		110,000		3	
677	Siegfried—Bethlehem Steel	1912							110,000		3	
	West North Central States (*Continued*)											
	Kansas Gas and Electric Co.					"S-S"	"T-T"	"T-T"				
678	Newton—Wichita		750	0		5,000	10,000	10,000	60,000		3	
679	Wichita—Midian		28,000	28,000		11,000	22,000	22,000	60,000		3	
680	Towanda S.S.—Peabody Sub					12,000	24,000	24,000	60,000		3	
681	Neosho—Midian		15,000	60,000		31,000	62,000	175,000	"U-U" 60,000		3	
682	Arkansas City—Augusta S. S.		1,250	0		7,200	14,400	14,400	60,000		3	
683	Augusta S. S.—Augusta											
684	Independence—Cherryvale		1,030	0		8,500	17,000	17,000	60,000		3	
685	Cherryvale—Neosho Loop		2,600	0		3,500	7,000	7,000	60,000		3	
686	Buffville—Fredonia					7,000	15,000	15,000	60,000		3	
687	Cherryvale—Buffville					14,000	27,000	27,000	60,000		3	
688	Cherryvale—Coffeyville					18,000	35,000	35,000	60,000		3	
689	Burrton—Buhler					7,000	74,000	74,000	60,000		3	
690	Burrton—Van Arsdale					15,000	30,000	30,000	60,000		3	
691	Valley—Center Midian					20,000	40,000	40,000	60,000		3	
692	Pittsburg—Mulberry					15,000	30,000	30,000	60,000		3	
	West South Central States— (*Continued*)											
	Texas Power and Light Co.											
693	Ft. Worth—Norwood	1914	130,000			20,000	40,000		60,000		3	
694	Norwood—Dallas	1914	130,000			20,000	40,000		60,000		3	
695	Norwood—Jenkins	1914	130,000			15,000	20,000		60,000		3	
696	Payne—Bonham	1916	130,000			2,000	5,000		60,000		3	
697	Jenkins—Commerce	1916	130,000			2,000	5,000		60,000		3	
698	Roye City—Terril	1924	130,000			2,000	5,000		60,000		3	
699	Dublin—Brownwood		130,000			2,000	5,000		60,000		3	
700	Jenkins—Trinity Hts	1914	130,000			10,000	15,000		60,000		3	
701	Waco—Taylor	1916	130,000			10,000	15,000		60,000		3	
702	Hillsboro—Leon Sta	1924	130,000				20,000		132,000		3	
703	Norwood—Bowie	1924	130,000				10,000		60,000		3	
704	Payne—Jenkins	1917	130,000						60,000		3	
705	Fort Worth—Waco	1913	130,000						60,000		3	
706	Hillsboro—Corsicana	1923	130,000				10,000		60,000		3	
707	Corsicana—Ferris	1917	130,000				10,000		60,000		3	
708	Trinity Hts.—Hillsboro	1916	130,000				20,000		60,000		3	
709	Corsican—Athens	1923	130,000				10,000		60,000		3	
710	Athens—Tylar	1923	130,000				5,000		60,000		3	
711	Athens—Palestine	1923	130,000				5,000		60,000		3	
712	Trinity Hts.—Dallas	1914	130,000				30,000		60,000		3	
	Mountain States (*Continued*)											
	Idaho Power Company											
713	Thousand Springs—Caldwell	1921	52,120						132,000		3	
714	Caldwell—Ontario	1923	52,120						132,000		3	
715	Pocatello—Blackfoot	1919	18,750						44,000		3	
716	American Falls—Pocatello	1922	18,750						44,000		3	
717	Malad—Boise	1911	52,120						44,000		3	
718	Swan Falls—Nompa	1906	52,120						44,000		3	
719	Swan Falls—Caldwell	1913—1918	52,120						66,000		3	
720	Thousand Springs—Jarbidge	1918	52,120						66,000		3	
721	Oxbow—Ontario	1909—12—14—16	52,120						66,000		3	
722	Swan Falls—Lower Salmon	1910—11—22	52,120						44,000		3	
723	Shoshone Falls—Oakley	1912	52,120						44,000		3	
724	Malad—Twin Falls	1914	52,120						44,000		3	
	Pacific States (*Continued*)											
725	White River—Mass St. (Seattle)		60,000	90,000		15,000	20,000		55,000		3	
726	White River—Mass St		60,000	90,000		15,000	20,000		55,000		3	
727	White River—Sta. A (Tacoma)		60,000	90,000		10,000	15,000		55,000		3	
728	White River—Sta. A (Tacoma)		60,000	90,000		10,000	12,000		55,000		3	
729	White River—Electron		80,000	110,000		20,000			55,000		3	
730	White River—Electron		80,000	110,000		20,000			55,000		3	
731	White R.—Jefferson St. (Seattle)		60,000	90,000		15,000	20,000		55,000		3	
732	White R.—Jefferson St. (Seattle		60,000	90,000		15,000	20,000		55,000		3	
733	Snoqualmie—Renton		20,000	26,000		12,000	15,000		55,000		3	
734	Snoqualmie—Renton		20,000	26,000		12,000	15,000		55,000		3	
735	Snoqualmie Falls Lumber Co		4,000			4,000			55,000		3	
736	White R.—19th St. (Tacoma)		60,000	90,000		10,000	12,000		55,000		3	
737	White R.—Smelter (Tacoma)		60,000	90,000		6,500	8,000		55,000		3	
738	Electron—Cumberland		20,000	20,000		3,500	4,500		55,000		3	
739	Fern Hill—Tenino					2,000	3,000		55,000		3	
740	Snoqualmie—Everett		20,000	26,000		2,500	3,000		55,000		3	
741	Snoqualmie—Everett		20,000	26,000		3,000	5,000		55,000		3	
742	White River—Wenatchee		60,000	90,000		15,000	20,000		110,000		3	
743	Tenino—Kalama		2,100	6,100		3,000	3,000		45,000		3	
744	Electron—Tenino		20,000	20,000		5,000	7,500		55,000		3	
745	Burlington—Anacortes								55,000		3	
746	Seattle—Everett								55,000		3	
747	White River—Cumberland		60,000	90,000		4,000	5,000		55,000		3	
	Utah Power and Light Co.											
748	Grace—Terminal	1914							130,000		3	
749	Ore—Terminal	1917							130,000		3	

	60	Delta Star						1	50.1	No. 1		Cu			
3	60							1	18.0		2/0	Cu			
3	60		Star Star	Yes	None	Newark		2	82.0		350,000	Al		66 Ve	
3	60	Delta Star						1	9.3	No. 1		Cu			
3	60	Delta Star						1	19.0	No. 1		Cu			
3	60		Yes	Yes		Sub. stat		1	16.8	No. 2		Cu		90 Ho	
3	60	Yes		Yes		P. H		1	16.0		266,800	Al		120 Ho	
3	60		Yes	Yes		Sub. Sta		1	61.4		266,800	Al		120 Ho	
3	60		Yes	Yes		Sub. sta		1	145.5		4/0	Al			
3	60	Yes		Yes		P. H. Sub. sta		1	63.9		266,800	Al		120 Ho	
3	60		Yes	Yes		Sub. sta		1	22.0		3/0	Cu		90 Ho	
3	60		Yes	Yes		Sub. sta		1	21.2	No. 2		Cu		90 Ho	
3	60	Yes		Yes		P. H. Sub. sta		1	22.0		3/0	Al			
3	60	Yes		Yes		P. H		1	27.0		1/0	Cu			
3	60		Yes	Yes		Sub. sta		1	135.0		3/0	Al			
3	60	Yes	Yes	Yes		All Sub. sta		1	58.0		3/0	Al			
3	60	Yes		Yes		P. H		2	31.0	No. 1		Cu		Mixed	
3	60	Yes		Yes		Sub. sta. P. H		1	129.0		266,800	Al		120 Ho	
3	60	Yes		Yes		P. H		1	13.5	No. 1		Cu			
3	60		Yes	Yes		Sub. sta		1	16.0		3/0	Cu		90 Ho	
3	60		Yes	Yes		Sub. sta		1	16.0		3/0	Cu		90 Ho	
3	60		Yes	Yes		Sub. sta		1	37.0		3/0	Al		90 Ho	
3	60		Yes	Yes		Sub. sta		1	151.2		3/0	Al			
3	60		Yes	Yes		Sub. sta		1	23.5	No. 2		Cu		90 Ho	
3	60		Yes	Yes		Sub. sta		1	138.1	No. 4		Cu			
3	60		Yes	Yes		Sub. sta		1	25.0	No. 2		Cu		78 Ve	
3	60		Yes	Yes		Sub. sta		1	69.0		3/0	Cu		78 Ve	
3	60		Yes	Yes		Sub. sta		1	28.0		266,800	Al		78 Ve	
3	60		Yes	Yes		Sub. sta		1	33.5		3/0	Al			
3	60		Yes	Yes		Sub. sta		1	22.0	No. 6		Cu		78 Ve	
3	60		Yes	Yes		Sub. sta		1	25.0	No. 2		Cu			
3	60		Yes	Yes		Sub. sta		1	6.0	No. 4		Cu			
3	60		Yes	Yes		Sub. sta		1	26.75	No. 4		Cu		78 Ve	
3	60	2,200 to 65,000	4,400—2,200—11,000					1	79		2/0	Cu			
3	60	2,200 to 65,000	4,400—2,200—11,000					1	92		2/0	Cu			
3	60	6,600 to 65,000	4,400—2,200—11,000					2	11		3/0	Cu			
3	60	2,200 to 65,000	4,400—2,200—11,000					1	81		2/0	Cu			
3	60							1	25.3	No. 2		Al		96 Ho	
3	60							1	22.1		2/0	A. C. S. R		96 Ho	
3	60							1	20.3	No. 2		Al		96 Ho	
3	60	11/66		Yes		Harwood		1	22.1		2/0	Cu			
3	60	11/66	66/4—66/11	Yes		Shenandoah		1	13.7	3/0 and No. 1		Al.—Cu			
3	60	11/66	66/11	Yes		Harwood		2	40.2		4/0	Cu			
3	60	11/66	66/11	Yes		Harwood—Hauto		2	19.6		250,000	Cu			
3	60	11/66		Yes		Hauto		1	21.8		4/0	Al			
3	60	11/66	66/4—66/11	Yes		Hauto—Shenandoah		1	16.8		3/0	Cu			
3	60	11/66		Yes		Hauto		1	23.5		250,000	Cu			
3	60		66/4—66/11	Yes		Shenandoah		1	12.7	No. 0		Cu			
3	60		66/4—66/11	Yes		Shenandoah		1	2.6	No. 1		Cu			
3	60		66/2.3					1	0.3	No. 4		Cu			
3	60		66/2.3					1	1.2	No. 2		Cu			
3	60		66/4					1	3.5		3/0	Al			
3	60		66/11					1	2.32		2/0	Cu			
3	60		66/22					1			4/0	Cu			
3	60							1	3.6		1/0	Cu			
3	60							1	14.1	No. 0—4/0		Cu			
3	60		66/4	Yes		Shamokin		1	19.6		2/0	Cu			
3	60		66/7.2					1	0.1		2/0	Cu			
3	60		66/7.3					1	0.5	No. 2		Cu			
3	60		66/4	Yes		Centralia		1	1.1	No. 4		Cu			
3	60		66/2.3					1	0.5	No. 1		Cu			
3	60		66/2.3					1	0.5	No. 1		Cu			
3	60		66/4	Yes				1	3.3		2/0	Cu			
3	60		66/4	Yes		Mt. Carmel		1	1.3	No. 1		Cu			
3	60		66/2.3					1	1.9		2/0	Cu			
3	60		66/22.5					1	14.0	No. 1		Cu			
3	60		66/4—66/11	Yes		Sunbury		1	24.5		2/0	Cu			
3	60		66/2.3—66/11					1	2.2	No. 1		Cu			
3	60		66/4	Yes		Shamokin		1	0.4		2/0	Cu			
3	60		66/2.3					1	0.8	No. 1		Cu			
3	60		66/2.3					1	3.0	No. 1		Cu			
3	60		66/2.3	Yes		Sunbury		1	14.4		2/0	Cu			
3	60		66/2.3—66/6.6					1	21.0		2/0	Cu			
3	60		66/11	Yes				1			1/0	Cu			
3	60	66/6.6	66/2.3					1	27.3		2/0	Cu			
3	60		66/11	Yes		Freeland		1	5.5		2/0	Cu			
3	60					Wilkes-Barre		1	4.0		3/0	Cu			
3	60		66/440V					2	20.4	No. 0		Cu			
3	60		66/22					2	4.2	No. 0		Cu			
3	60		66/13.2					1	3.2		2/0—4/0	Cu			
3	60	13.2/66						2	19.7		4/0	Cu			
3	60	13.2/66	66/13.2	Yes		Freemansburg		1	8.0		3/0	Cu			
3	60	11/110	110/22	Yes	125 ohms	Hauto		2	47.7		250,000	Cu			
3	60		110/6.6					1	2.2—11.1	250,000—[-inch		Cu.—Steel			
3	60	Star Star	Delta Delta	Yes				1	28.5	No. 2		Cu		72 ve	
3	60	Star Star	Delta Star Delta Delta	Yes				1	35.2		2/0	Cu		96 ho	
3	60		Delta Star					1	18.0	No. 2		Cu		96 ho	
3	60	Delta Star	Delta Star	Yes				2	213.8		3/0	Eq. Al		252 h	
3	60	Delta Delta	Delta Delta					1	46.5		2/0	Cu		96 ho	
									5.5		2/0	Cu		96 ho	
3	60		Delta Delta					1	8.6	No. 3		Cu		66 ve	
3	60	Delta Delta	Delta Delta					1—2	60.8		1/0—1/0	Cu.—Eq. Al		96 ho	
3	60		Delta Delta					1	10.0	No. 4		Cu		96 ho	
3	60		Delta Delta					1	16.7		2/0	Cu		96 ho	
3	60		Delta Star	Yes				1	17.0		3/0	Eq. Al		72 ve	
3	60		Delta Delta					1	9.5	No. 4		Cu		84 ho	
3	60		Delta Delta					1	14.4	No. 2		Eq. Al		96 ho	
3	60		Delta Star Delta Delta	Yes				1	24.5		3/0	Eq. Al		96 ho	
3	60		Delta Delta	Yes				1	14.6		2/0	Cu		96 ho	
3	60		Star Star	Yes			W-W	2	26	No. 1		Cu			
3	60		Star Star	Yes			W-W	2	7		2/0	Cu			
3	60		Delta Star	No			W-W	1	11	No. 1		Cu			
3	60		Star Star	Yes			W-W	1	28	No. 2		Cu			
3	60		Delta Delta	No			W-W	1	61	No. 1		Cu			
3	60		Star Star	Yes			W-W	1	17.3		3/0	Al			
3	60		Delta Delta	No			W-W	1	47	No. 4		Cu			
3	60		Delta Delta	No			W-W	1	18	No. 1		Cu			
3	60		Delta Delta	No			W-W	1	79		3/0	Al			
3	60	Star Star	Star Delta	Yes				1	100		4/0	A. C. S. R			
3	60		Star Star	Yes				1	91		4/0	A. C. S. R			
3	60	Delta Star	Star Star					1	54		1/0	Cu			
3	60		Delta Star	Yes				2	102		1/0	Cu			
3	60	Star Star	Star Star					1	41		3/0	A. C. S. R			
3	60		Delta Delta					1	35	No. 1		Cu			
3	60		Delta Delta					2	73						
3	60	Delta	Delta Delta					1	38		2/0	Al			
3	60	Delta	Delta Delta					1	33		2/0	Al			
3	60	Delta	Delta Delta					1	35		2/0	Al			
3	60	Delta	Star Star	Yes				1	5		2/0	Al			
3	60							1	114.2		4/0	Al			
3	60							1	29.0		4/0	Al			
3	60							1	23.9		1/0	Cu			
3	60	Delta Star				Am. Falls		1	23.0		4/0	Cu			
3	60	Delta Star				Malad		1	89.6	No. 2		Cu			
3	60	Delta Delta						1	26.2		1/0	Al			
3	60	Delta Delta						1	43.3	No. 1		Cu			
3	60	Delta Delta						1	71.6	3—No. 8		Cu			
3	60	Delta Delta						1	83.1	No. 1		Cu.—Eq. Al			
3	60	Delta Delta						1	91.7	No. 1		Cu			
3	60	Delta Star				Shos. Falls		1	46.3	No. 4		Cu			
3	60	Delta Star				Malad		1	40.1	No. 5		Cu			
3	60	Delta	Delta	Delta Ungr				1	28.4		4/0	Cu		6 ft.	
3	60	Delta	Delta	Delta Ungr				1	27.0		4/0	Cu		6 ft.	
3	60	Delta	Delta	Delta Ungr				1	12.5		4/0	Cu		6 ft.	
3	60	Delta	Delta	Delta Ungr				1	12.6		1/0	Cu		6 ft.	
3	60	Delta	Delta	Delta Ungr				1	20.1		4/0	Cu		6 ft.	
3	60	Delta	Delta	Delta Ungr				1	20.1		4/0	Cu		6 ft.	
3	60	Delta	Delta	Delta Ungr				1	30.9		336,400	Al		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	30.9		336,400	Al		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	19.1		4/0	Al		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	19.1		4/0	Al		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	1.4	No. 4		Cu		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	10.7		2/0	Al		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	11.4—17.1	2/0—No. 4		Cu		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	25.5	No. 4		Cu		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	44.1	No. 4		Cu		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	52.1	No. 4		Cu		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	39.3	No. 4		Cu		7 ft.	
3	60	Delta	Star	Delta Ungr				1	112.1—8.5		2/0—4/0	Cu		X-X	
3	60	Delta	Delta	Delta Ungr				1	75	No. 4		Cu		5 ft.	
3	60	Delta	Delta	Delta Ungr				1	37.7		4/0	Cu		10 ft.	
3	60	Delta	Delta	Delta Ungr				1	18.5	No. 4		Cu		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	22.6		100,000	Al		7 ft.	
3	60	Delta	Delta	Delta Ungr				1	22.7	No. 4		Cu		7 ft.	
3	60	Delta Delta	Star Star	Solid		Terminals		2	266.6		250,000	Cu			
3	60	Delta Delta	Star Star	Solid		Terminals		1	134.4		250,000	Cu			
								1	9.5		250,000	Cu			

		747	White River—Cumberland																			
			Utah Power and Light Co.																			
		748	Grace—Terminal				1914											130,000	3	60		
		749	Grace—Terminal				1917											130,000	3	60		
2/0	Cu.	42	30	30	34	8	200	400	1.5	1,500	Pin, 66 kv.	Various	Pin, 66 kv.	Various
350,000	Al.	66 Vert.	30	30	34	8	200	400	4.0	3,200	Pin, 66 kv.	Various	Pin, 66 kv.	Various
	Cu.	84	30	30	34	8	175	400	1.2	1,000	Pin, 66 kv.	Various	Pin, 66 kv.	Various
	Cu.	84	30	30	34	8	150	300	1.0	1,000	Pin, 66 kv.	Various	Pin, 66 kv.	Various
	Cu.	90 Horiz.—78 Vert.					352				4		5	
266,800	Al.	120 Horiz.—120 Vert.					580				7		8	
266,800	Al.	120 Horiz.—120 Vert.					580				4		8	
4/0	Al.	84					580				1 pin.		5	
266,800	Al.	120 Horiz.—120 Vert.					580				7		8	
3/0	Cu.	90 Horiz.—78 Vert.					352				4		5	
	Cu.	90 Horiz.—78 Vert.					352				4		5	
3/0	Al.	108					352				1 pin.		5	
1/0	Cu.	84					352				1 pin.		5	
3/0	Al.	108					352				1 pin.		5	
3/0	Al.	108					352				1 pin.		5	
	Cu.	Mixed Constr.					150				4–1 pin.		8	
266,800	Al.	120 Horiz.—120 Vert.					580				7		5	
	Cu.	84					352				1 pin.		5	
3/0	Cu.	90 Horiz.—78 Vert.					352				4		5	
3/0	Cu.	90 Horiz.—78 Vert.					352				4		5	
3/0	Al.	90 Horiz.—78 Vert.					352				4		5	
3/0	Al.	84					352	2,640			1 pin.		5	
	Cu.	90 Horiz.—78 Vert.					352				4		5	
	Cu.	108					352				1 pin.		5	
	Cu.	78 Vert.—90 Horiz.					352				4		5	
3/0	Cu.	78 Vert.—90 Horiz.					352				4		5	
266,800	Al.	78 Vert.—90 Horiz.					352				4		5	
3/0	Al.	108					352				1 pin.		5	
	Cu.	78 Vert.—90 Horiz.					352				4		5	
	Cu.	84					352				4		5	
	Cu.	84					352				4		5	
	Cu.	78 Vert.—90 Horiz.					352							
2/0	Cu.	46	35	35	40	10	375	265	3.5	2,490	Pin	Locke, No. 351		
2/0	Cu.	46	35	35	40	10	265	265	2.0	2,350	Pin	Locke, No. 351		
3/0	Cu.						800	2,000	16.0	3,020	Pin	Gen. Elec.		
2/0	Cu.	46	35	35	35	10	175	265	1.75	1,898	Pin	Gen. Elec.		
	Al.	96 Horiz.	32	32	34	8	300	350	4	300	1 pin.	Locke	5	Ohio B
2/0	A. C. S. R.	96 Horiz.	33.5	33.5	34	8	300	353	2.5	900	1 pin.	Locke	5	Ohio B
	Al.	96 Horiz.	32	32	34	8	300	406	4	300	1 pin.	Locke	5	Ohio B
2/0	Cu.	72	27	27			150	750			1 pin.		6 disc	
	Al.—Cu.	48	27	27			160	1,110	Al. 1.95	Al. 260	1 pin.		6 disc	
4/0	Cu.	96	27	27	38.5	12.7	600	1,403			4 disc		6 disc	
250,000	Cu.	48	27	27	35.25	11.0	400	1,237	10.0	1,550	3 disc—1 pin.		6 disc	
4/0	Al.	96	27	27			700	1,844	13.0	1,385	4 disc		6 disc	
3/0	Cu.	96	27	27	38.0	12.5	575	1,110	*M-M*27.7	*M-M*780	4 disc			
									*N-N*19.8	*N-N*1,070				
250,000	Cu.	96	27	27	39.3	13.2	650	1,107	*M-M*35.5	*M-M*780	4 disc		6 disc	
									*N-N*25.2	*N-N*1,070				
	Cu.	66	27	27	34.75	10.9	375	800			4 disc—1 pin.		6 disc	
	Cu.	66	27	27	34.75	10.9	375	604			4 disc		6 disc	
	Cu.		27	27	31.0	8.9	150	180			1 pin.		6 disc	
	Cu.		27	27	31.0	8.9	150	180			1 pin.		6 disc	
3/0	Al.	48	27	27			160	200	Al. 1.95	Al. 260	4 disc—1 pin.		6 disc	
2/0	Cu.		27	27	31.6	9.2	175	180	2.1	720	4 disc			
4/0	Cu.													
1/0	Cu.										1 pin.		6 disc	
	Cu.	66	27	27	32.75	9.9	250	1,535			4 disc—1 pin.		6 disc	
2/0	Cu.	96	27	27	38.5	12.75	600	1,465	21.2	870	4 disc		6 disc	
2/0	Cu.		27	27	31.2	9.0	165	220	1.9	720	1 pin.		6 disc	
	Cu.		27	27	31.5	9.2	175	203			1 pin.		6 disc	
	Cu.		27	27	31.9	9.5	200	208			1 pin.		6 disc	
	Cu.		27	27	31.0	8.9	150	188	2.0	365	1 pin.		6 disc	
	Cu.		27	27	31.5	9.2	175	200	2.7	365	1 pin.		6 disc	
2/0	Cu.	72	27	27	31.9	9.5	150	420			1 pin.		6 disc	
	Cu.	60	27	27	31.0	8.9	150	200			1 pin.		6 disc	
2/0	Cu.		27	27	32.7	9.9	250	380	4.4	720	1 pin.		6 disc	
	Cu.	72	27	27	34.8	10.9	375	1,700	8.3	720	4 disc		6 disc	
2/0	Cu.	96	27	27	31.9	9.5	200	1,191	2.8	720	1 pin.		6 disc	
	Cu.	72	27	27	31.5	9.2	175	200	3.7	265	1 pin.		6 pin.	
2/0	Cu.	72	27	27	32.3	9.6	220	235			1 pin.		6 disc	
	Cu.		27	27	31.5	9.2	175	800	2.7	365	1 pin.		6 disc	
	Cu.		27	27	31.2	9.0	160	640	1.9	450	1 pin.		6 disc	
2/0	Cu.	96	27	27	31.9	9.5	200	1,029	2.8	720	1 pin.		6 disc	
2/0	Cu.	96	27	27	31.9	9.5	200	1,310	2.8	720	1 pin.		6 disc	
1/0	Cu.										1 pin.		6 disc	
2/0	Cu.	96	27	27	31.9	9.4	200	1,310	2.8	720	1 pin.		6 disc	
2/0	Cu.	96	27	27	35.6	11.3	425	580	*M-M*17.9	*M-M*505	4 disc		6 disc	
									*N-N*12.6	*N-N*720				
3/0	Cu.	96	27	27	38.5	12.7	600	1,057	21.5	1,070	4 disc		6 disc	
	Cu.	72	27	27	38.5	12.7	600	1,271	21.0	680	4 disc		6 disc	
	Cu.		27	27	38.5	12.7	600	700			4 disc		6 disc	
2/0—4/0	Cu.	96	27	27	31.9		175	802			1 pin.		6 disc	
4/0	Cu.	96	27	27	38.7	12.7	600	940			4 disc		6 disc	
3/0	Cu.	96	27	27	39.3	13.1	650	1,072	25.2	1,070	4 disc			
250,000	Cu.	120	27	27	38.0	12.5	575	1,524			7 disc		8 disc	
	Cu.—Steel	120	27	27			600	720	*P-P*38		7 disc		8 disc	
									*R-R*22.5					
									V-V	*V-V*				
	Cu.	72 vert.—72 hor.	35.0	35	35	6	110	110	0.35	820	1 pin.	Thomas, 4,000	6	Hewle
2/0	Cu.	96 hor.—60 ver.	20.0	22	30	6	275	400	4.2	687	1 pin.	Ohio Brass, 10,748	6	Hewle
	Cu.	96 hor.—60 vert.	20.0	22	30	6	265	400	6.3	281	4 sus.	Thomas, 1,141	6 sus.	Thom
3/0	Eq. Al.	252 hor.—156 vert.	27.0	27	33.3	9.3	850	1,350	14.5	2,160	9 sus.	Locke, 5,757	2 str. of 11 sus.	Locke,
2/0	Cu.	96 hor.—60 vert.	20	22	30	6	275	400	4.2	687	1 pin.	Ohio Brass, 10,748	6	Hewle
2/0	Cu.	96 hor.—60 vert.	27	27	32	6	275	386	3.8	1,050	1 pin.	Ohio Brass, 10,748	6	Hewle
	Cu.	66 vert.	20	22	30	7	225	400	3.5	295	1 pin.	Thomas, 4,032	5 sus.	Thom
1/0—1/0	Cu.—Eq. Al.	96 hor.—72 vert.	25	25	30	7	285—210	400—210	3.2—0.7	1,050—1,215	5 sus.	Locke, 5,757	6 sus.	Locke,
	Cu.	96 hor.—60 vert.	28	28	32	7	250	400	7.4	133	1 pin.	Ohio Brass, 10,748	6 sus.	Locke,
2/0	Cu.	96 hor.—60 vert.	28.5	28.5	32	7	275	400	3.7	1,050	1 pin.	Ohio Brass, 10,748	6 sus.	Locke,
3/0	Eq. Al.	72 vert.—120 hor.	29	29	32	7	600—250	1,010—400	8.6—2.0	1,215	4 sus.	Locke, 5,757	2 str. of 6 sus.	Locke,
	Cu.	84 hor.—60 vert.	24	24	35	6	275	345	9.0	135	1 pin.	Thomas, 4,000	5 sus.	Thom
	Eq. Al.	96 hor.—72 vert.	31.7	31.7	35	6	310	356	2.7	800	4 sus.	Thomas, 1,141	5 sus.	Thom
3/0	Eq. Al.	96 hor.—60 vert.	20	22	30	6	275	350	5.6	570	1 pin.	Ohio Brass, 10,748	6	Hewle
2/0	Cu.	96 hor.—60 vert.	28.5	28.5	32	7	275	350	3.7	1,050	1 pin.	Ohio Brass, 10,748	6	Hewle
	Cu.	120	30	30	30	10	600	700	16		4 disc	Ohio Brass	6 disc	Ohio
2/0	Cu.	120	30	30	30	10	600	700	16		4 disc	Ohio Brass	6 disc	Ohio
	Cu.	120	30	30	30	10	600	700	16		4 disc	Ohio Brass	6 disc	Ohio
	Cu.	60	30	30	30	10	300	400	10		1 pin.	Ohio Brass	6 disc	Ohio
	Cu.	96	30	30	30	10	300	400	10		4 disc	Ohio Brass	6 disc	Ohio
3/0	Al.	96	30	30	30	10	300	400	10		4 disc	Ohio Brass	6 disc	Ohio
	Cu.	72	30	30	30	10	300	400	10		1 pin.	Ohio Brass	6 disc	Ohio
	Cu.	96	30	30	30	10	600	750	16		4 disc	Ohio Brass	6 disc	Ohio
3/0	Al.	96	30	30	30	10	300	900	10		4 disc	Ohio Brass	6 disc	Ohio
4/0	A. C. S. R.	174	26	25	35	9	350	1,110	12	2,350	1 disc	Ohio Brass, Locke	11 disc	Ohio
4/0	A. C. S. R.	114	25	25	35	10	550	960	12	2,350	4 disc	Ohio Brass	7 disc	Ohio
1/0	Cu.	72	25	25	35	10	275	350	9	940	Pin	Ohio Brass	7 disc	Ohio
1/0	Cu.	96	25	25	35	10	600	800	14	940	4 disc	Ohio Brass	7 disc	Ohio
3/0	A. C. S. R.	78	25	25	35	10	300	400	10		Pin	Ohio Brass	7 disc	Ohio
	Cu.	120	25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc	Ohio
			25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc	Ohio
2/0	Al.	120	25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc	Ohio
2/0	Al.	120	25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc	Ohio
2/0	Al.	120	25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc	Ohio
2/0	Al.	96	25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc	Ohio
4/0	Al.	168	34.5		34.5 Min.		550		5.5		9 discs	Locke, Ohio Brass	11 discs	Locke,
4/0	Al.	168	34.5		34.5 Min.		550		5.5		9 discs	Westinghouse, 286,270	11 discs	Westin
1/0	Cu.	66—84	28.7		29 Min.	6.5	300		3.1		3 discs	Ohio Brass, 12,464	4 discs	Ohio B
4/0	Cu.	66—84	29.5			6.5	250		2.3		Pin	Thomas		
	Cu.	86	23		29 Min.	6	300		4.2		Pin			
1/0	Al.	86	20.7		29 Min.	5	300		7.5		Pin	Locke, 315		
	Cu.	66—84	20.5		30.2 Min.	5	300		3.3		Pin	Locke, Thomas	7 units	Thoma
	Cu.	84	22.3				300		5.8		Pin	Ohio Brass, Thomas, Locke		
	Cu.—Eq. Al.	88—72	25—24		30.2 Min.	6—4	225—300		2.0—3.3		Pin	Thomas, Pittsburg		
	Cu.	66—84	24—23			6	210—300		2.0—3.3		Pin	Thomas, Locke, Ohio Brass		
	Cu.	60	27.2		29 Min.	6	300		5.8		Pin	Locke, 315		
	Cu.	72	22.3			6	600		5.8		Pin	Ohio Brass, Pittsburg		
4/0	Cu.	6 ft. △	28			7	135				Pin		Z-Z	
4/0	Cu.	6 ft. △	28			7	135				Pin		Z-Z	
4/0	Cu.	6 ft. △	28			7	135				Pin		Z-Z	
1/0	Cu.	6 ft. △	28			7	135				Pin		Z-Z	
4/0	Cu.	6 ft. △	28			7	135				Pin		Z-Z	
4/0	Cu.	6 ft. △	28			7	135				Pin		Z-Z	
336,400	Al.	7 ft. △	42			15	300				Pin		Z-Z	
336,400	Al.	7 ft. △	42			15	300				Pin		Z-Z	
4/0	Al.	7 ft. △	42			15	300				Pin		Z-Z	
4/0	Al.	7 ft. △	42			15	300				Pin		Z-Z	
	Cu.	7 ft. △									Pin		Z-Z	
2/0	Al.	7 ft. △	42				300				Pin		Z-Z	
	Cu.	7 ft. △	42			15	300				Pin		Z-Z	
	Cu.	7 ft. △	42			15	300				Pin		Z-Z	
	Cu.	7 ft. △	42			15	300				Pin		Z-Z	
	Cu.	7 ft. △	42				150				Pin		Z-Z	
	Cu.	7 ft. △	42			15	300				Pin		Z-Z	
2/0—4/0	Cu.	X-X 14.5 ft.—23.9 ft.	42								6 sus.		7 sus.	Ohio B
4/0	Cu.	5 ft. △	30			7	132				Pin	Ohio Brass, Thomas	3 sus.	Locke,
	Cu.	10 ft. △	30				415				3 sus.	Thomas	5 sus.	Thoma
100,000	Al.	7 ft. △	42				250				Pin	Ohio Brass	5 sus.	
	Cu.	7 ft. △	42				150				Pin		3 strain.	Jeffrey
													Z-Z	
250,000	Cu.	156					652				10 sus.	Ohio Brass	12 sus.	Ohio B
250,000	Cu.	156					500				10 sus.	Ohio Brass	12 sus.	Ohio B
250,000	Cu.	156					500						12 sus.	Ohio B

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Each structure			2											749			
Each structure			2											750			
3	60		11/66														
3	60		11/66	66/4—66/11	Yes		Shenandoah										
3	60		11/66	66/11	Yes		Harwood		2	40.2		4.0	Cu.				
3	60		11/66	66/11	Yes		Harwood—Hauto		2	19.6		250,000	Cu.				
3	60		11/66		Yes		Hauto		1	21.8		4/0	Al.				
3	60		11/66	66/4—66/11	Yes		Hauto—Shenandoah		1	16.8		3/0	Cu.				
3	60		11/66		Yes		Hauto		1	23.5		250,000	Cu.				
3	60			66/4—66/11	Yes		Shenandoah		1	12.7	No. 0		Cu.				
3	60			66/4—66/11	Yes		Shenandoah		1	2.6	No. 1		Cu.				
3	60			66/2.3					1	0.3	No. 4		Cu.				
3	60			66/2.3					1	1.2	No. 2		Cu.				
3	60			66/4					1	3.5		3/0	Al.				
3	60			66/11					1	2.32		2/0	Cu.				
3	60			66/22					1			4/0	Cu.				
3	60								1	3.6		1/0	Cu.				
3	60								1	14.1	No. 0—4/0		Cu.				
3	60			66/4	Yes		Shamokin		1	19.6		2/0	Cu.				
3	60			66/7.2					1	0.1		2/0	Cu.				
3	60			66/7.3					1	0.5	No. 2		Cu.				
3	60			66/4	Yes		Centralia		1	1.1	No. 4		Cu.				
3	60			66/2.3					1	0.5	No. 1		Cu.				
3	60			66/2.3					1	0.5	No. 1		Cu.				
3	60			66/4	Yes				1	3.3		2/0	Cu.				
3	60			66/4	Yes		Mt. Carmel		1	1.3	No. 1		Cu.				
3	60			66/2.3					1	1.9		2/0	Cu.				
3	60			66/22.5					1	14.0	No. 1		Cu.				
3	60			66/4—66/11	Yes		Sunbury		1	24.5		2/0	Cu.				
3	60			66/2.3—66/11					1	2.2	No. 1		Cu.				
3	60			66/4	Yes		Shamokin		1	0.4		2/0	Cu.				
3	60			66/2.3					1	0.8	No. 1		Cu.				
3	60			66/2.3					1	3.0	No. 1		Cu.				
3	60			66/2.3	Yes		Sunbury		1	14.4		2/0	Cu.				
3	60			66/2.3—66/6.6					1	21.0		2/0	Cu.				
3	60			66/11	Yes				1			1/0	Cu.				
3	60		66/6.6	66/2.3					1	27.3		2/0	Cu.				
3	60			66/11	Yes		Freeland		1	5.5		2/0	Cu.				
3	60						Wilkes-Barre		1	4.0		3/0	Cu.				
3	60			66/440V					2	20.4	No. 0		Cu.				
3	60			66/22					2	4.2	No. 0		Cu.				
3	60			66/13.2					1	3.2		2/0—4/0	Cu.				
3	60		13.2/66						2	19.7		4/0	Cu.				
3	60		13.2/66	66/13.2	Yes		Freemansburg		1	8.0		3/0	Cu.				
3	60		11/110	110/22	Yes	125 ohms	Hauto		2	47.7		250,000	Cu.				
3	60			110/6.6					1	2.2—11.1	250,000—1-inch		Cu.—Steel				
3	60	Star Star		Delta Delta	Yes				1	28.5	No. 2		Cu.				72 vert.
3	60	Star Star		Delta Star Delta Delta	Yes				1	35.2		2/0	Cu.				96 hor.
3	60			Delta Star					1	18.0	No. 2		Cu.				96 hor.
3	60	Delta Star		Delta Star	Yes				2	213.8		3/0	Eq. Al.				252 hor.
3	60	Delta Delta		Delta Delta					1	46.5		2/0	Cu.				96 hor.
										5.5		2/0	Cu.				96 hor.
3	60			Delta Delta					1	8.6	No. 3		Cu.				66 vert.
3	60	Delta Delta		Delta Delta					1—2	60.8		1/0—1/0	Cu.—Eq. Al.				96 hor.
3	60			Delta Delta					1	10.0	No. 4		Cu.				96 hor.
3	60			Delta Delta					1	16.7		2/0	Cu.				96 hor.
3	60			Delta Star	Yes				1	17.0		3/0	Eq. Al.				72 vert.
3	60			Delta Delta					1	9.5	No. 4		Cu.				84 hor.
3	60			Delta Delta					1	14.4	No. 2		Eq. Al.				96 hor.
3	60			Delta Star Delta Delta	Yes				1	24.5		3/0	Eq. Al.				96 hor.
3	60			Delta Delta	Yes				1	14.6		2/0	Cu.				96 hor.
3	60			Star Star	Yes		W-W		2	26	No. 1		Cu.				
3	60			Star Star	Yes		W-W		2	7		2/0	Cu.				
3	60			Delta Star	No		W-W		1	11	No. 1		Cu.				
3	60			Star Star	Yes		W-W		1	28	No. 2		Cu.				
3	60			Delta Delta	No		W-W		1	61	No. 1		Cu.				
3	60			Star Star	Yes		W-W		1	17.3		3/0	Al.				
3	60			Delta Delta	No		W-W		1	47	No. 4		Cu.				
3	60			Delta Delta	No		W-W		1	18	No. 1		Cu.				
3	60			Delta Delta	No		W-W		1	79		3/0	Al.				
3	60	Star Star		Star Delta	Yes				1	100		4/0	A. C. S. R.				
3	60			Star Star	Yes				1	91		4/0	A. C. S. R.				
3	60	Delta Star		Star Star					1	54		1/0	Cu.				
3	60			Delta Star	Yes				2	102		1/0	Cu.				
3	60	Star Star		Star Star					1	41		3/0	A. C. S. R.				
3	60			Delta Delta					1	35	No. 1		Cu.				
3	60			Delta Delta					2	73							
3	60	Delta		Delta Delta					1	38		2/0	Al.				
3	60	Delta		Delta Delta					1	33		2/0	Al.				
3	60	Delta		Delta Delta					1	35		2/0	Al.				
3	60	Delta		Star Star	Yes				1	5		2/0	Al.				
3	60								1	114.2		4/0	Al.				
3	60								1	29.0		4/0	Al.				
3	60								1	23.9		1/0	Cu.				
3	60	Delta Star					Am. Falls		1	23.0		4/0	Cu.				
3	60	Delta Star					Malad		1	89.6	No. 2		Cu.				
3	60	Delta Delta							1	26.2		1/0	Al.				
3	60	Delta Delta							1	43.3	No. 1		Cu.				
3	60	Delta Delta							1	71.6	3—No. 8		Cu.				
3	60	Delta Delta							1	83.1	No. 1		Cu.—Eq. Al.				
3	60	Delta Delta							1	91.7	No. 1		Cu.				
3	60	Delta Star					Shos. Falls		1	46.3	No. 4		Cu.				
3	60	Delta Star					Malad		1	40.1	No. 5		Cu.				
3	60	Delta		Delta	Delta Ungr.				1	28.4		4/0	Cu.				6 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	27.0		4/0	Cu.				6 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	12.5		4/0	Cu.				6 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	12.6		1/0	Cu.				6 ft. Δ
3	60	Delts		Delta	Delta Ungr.				1	20.1		4/0	Cu.				6 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	20.1		4/0	Cu.				6 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	30.9		336,400	Al.				7 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	30.9		336,400	Al.				7 ft. Δ
3	66	Delta		Delta	Delta Ungr.				1	19.1		4/0	Al.				7 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	19.1		4/0	Al.				7 ft. Δ
3	00	Delta		Delta	Delta Ungr.				1	1.4	No. 4		Cu.				7 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	10.7		2/0	Al.				7 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	11.4—17.1	2/0—No. 4		Cu.				7 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	25.5	No. 4		Cu.				7 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	44.1	No. 4		Cu.				7 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	52.1	No. 4		Cu.				7 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	39.3	No. 4		Cu.				7 ft. Δ
3	60	Delta		Star	Delta Ungr.				1	112.1—8.5		2/0—4/0	Cu.				X-X 1
3	60	Delta		Delta	Delta Ungr.				1	75	No. 4		Cu.				5 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	37.7		4/0	Cu.				10 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	18.5	No. 4		Cu.				7 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	22.6		100,000	Al.				7 ft. Δ
3	60	Delta		Delta	Delta Ungr.				1	22.7	No. 4		Cu.				7 ft. Δ
3	60	Delta Delta		Star Star	Solid		Terminals		2	266.6		250,000	Cu.				
3	60	Delta Delta		Star Star	Solid		Terminals		1	134.4		250,000	Cu.				
3	60	Delta Delta							1	9.5		250,000	Cu.				
3	60	Delta Delta							1	46.6	No. 0		Cu.				
3	60	Delta Delta							1	80.5	No. 1		Cu.				
3	60	Delta Delta		Delta Delta					1	59.0	No. 1		Cu.				
3	60								1	132.4	Nos. 7 and 8		Cu. and Al.				Various
3	60								1	132.6	Various		Cu.				Various
3	60								1	44.5	No. 1		Cu.				
3	60								1	94.2	Nos. 1 and 2		Cu.				
3	60								2	74.0	No. 0		Cu.				
3	60								2	8.8	2/0 and 4/0		Cu.				
3	60								1	32.6	No. 2		Cu.				
3	60								1	18.8	Various		Cu.				
3	60								1	23.4	No. 0		Cu.				
3	60								1	20.8	No. 2		Cu.				
3	60								1	12.4	No. 2		Cu.				
3	60								1	12.4	No. 2		Cu.				
3	60								1	42.3	No. 2		Cu.				
3	60								1	43.0	No. 6		Cu.				
3	60								1	19.2	No. 2		Cu.				
3	60								1	21.7	No. 0		Cu.				
3	60								1	45.7	No. 0		Cu.				
3	60								1	71.0		4/0	Steel Core Cu.				
3	60								1	55.0		2/0	Cu.				
3	60								1	3.6	No. 2		Cu.				
3	60								1	16.9	No. 2		Cu.				
3	60								1	16.0	Nos. 3 and 8		Cu.				
3	60								1	16.9	Nos. 3 and 8		Cu.				
3	60								1	30.3	No. 0		Cu.				

signed [illegible]0,000 volts.
formers at every generating
ation.
rounded solidly at Y point
transformer connection at
n.
re.
ole lines.

g—None at present; carrier current ultimate.
h—Per circuit.
i—Installed transformer capacity.
j—Distances are between stations.
k—66,000 volt at present, 110,000 proposed.
l—To company line.

m—45,000 volt at present, future 110,000 volt.
n—Does not include any capacity of Metropolitan Edison Co. system.
p—66 kw. tie with M. E. Co. system.
q—2 plants.
r—May be raised to 110,000 volts.
s—Connection to Adirondack L. & P. Co.

t—Built for 110,000 volts.
u—Rating at lines based on 10% voltage drop, 85% P. F. 60 cycles.
v—½ A. P. & L. Corp. and ½ United Hudson El. Corp.
w—1 now, 1 in future.
x—Lines combined.
y—Does not include river span of 2,011

feet or
z—C
A—S
maint
B—
Tower
tower.
C—V

		None	None		Wood	Wood	Steel							None			
		None	None		Wood	Steel	Steel	None						None			
		None	None		Steel	Steel—Wood	Steel—Wood	Steel						None			
		None	None		Steel	Steel	Steel	None									

	Al.—Cu	48	27	27			160	1,110	Al. 1.95	Al. 260	1 pin		6 disc				
4/0	Cu	96	27	27	38.5	12.7	600	1,403			4 disc		6 disc				
0,000	Cu	48	27	27	35.25	11.0	400	1,237	10.0	1,550	3 disc—1 pin		6 disc				
4/0	Al	96	27	27			700	1,844	13.0	1,385	4 disc		6 disc				
3/0	Cu	96	27	27	38.0	12.5	575	1,110	*M-M*27.7 *N-N*19.8	*M-M*789 *N-N*1,070	4 disc		6 disc				
0,000	Cu	96	27	27	39.3	13.2	650	1,107	*M-M*35.5 *N-N*25.2	*M-M*780 *N-N*1,070	4 disc		6 disc				
	Cu	66	27	27	34.75	10.9	375	800			4 disc—1 pin		6 disc				
	Cu	66	27	27	34.75	10.9	375	604			4 disc		6 disc				
	Cu		27	27	31.0	8.9	150	180			1 pin		6 disc				
	Cu		27	27	31.0	8.9	150	180			1 pin		6 disc				
3/0	Al	48	27	27			160	200	Al. 1.9	Al. 260	4 disc—1 pin		6 disc				
2/0	Cu		27	27	31.6	9.2	175	180	2.1	720	4 disc		6 disc				
4/0	Cu																
1/0	Cu										1 pin		6 disc				
	Cu	66	27	27	32.75	9.9	250	1,535			4 disc—1 pin		6 disc				
2/0	Cu	96	27	27	38.5	12.75	600	1,465	21.2	870	4 disc		6 disc				
2/0	Cu		27	27	31.2	9.0	165	220	1.9	720	1 pin		6 disc				
	Cu		27	27	31.5	9.2	175	203			1 pin		6 disc				
	Cu		27	27	31.9	9.5	200	208			1 pin		6 disc				
	Cu		27	27	31.0	8.9	150	188	2.0	365	1 pin		6 disc				
	Cu		27	27	31.5	9.2	175	200	2.7	365	1 pin		6 disc				
2/0	Cu	72	27	27	31.9	9.5	150	420			1 pin		6 disc				
	Cu	60	27	27	31.0	8.9	150	200			1 pin		6 disc				
2/0	Cu		27	27	32.7	9.9	250	380	4.4	720	1 pin		6 disc				
	Cu	72	27	27	34.8	10.9	375	1,700	8.3	720	4 disc		6 disc				
2/0	Cu	96	27	27	31.9	9.5	200	1,191	2.8	720	1 pin		6 disc				
	Cu	72	27	27	31.5	9.2	175	200	3.7	265	1 pin		6 disc				
2/0	Cu	72	27	27	32.3	9.6	220	235			1 pin		6 pin				
	Cu		27	27	31.5	9.2	175	800	2.7	365	1 pin		6 disc				
	Cu		27	27	31.2	9.0	160	640	1.9	450	1 pin		6 disc				
2/0	Cu	96	27	27	31.9	9.5	200	1,029	2.8	720	1 pin		6 disc				
2/0	Cu	96	27	27	31.9	9.5	200	1,310	2.8	720	1 pin		6 disc				
1/0	Cu										1 pin		6 disc				
2/0	Cu	96	27	27	31.9	9.4	200	1,310	2.8	720	1 pin		6 disc				
2/0	Cu	96	27	27	35.6	11.3	425	580	*M-M*17.9 *N-N*12.6	*M-M*505 *N-N*720	4 disc		6 disc				
3/0	Cu	96	27	27	38.5	12.7	600	1,057	21.5	1,070	4 disc		6 disc				
	Cu	72	27	27	38.5	12.7	600	1,271	21.0	680	4 disc		6 disc				
	Cu		27	27	38.5	12.7	600	700			4 disc		6 disc				
4/0	Cu	96	27	27	31.9		175	802			1 pin		6 disc				
4/0	Cu	96	27	27	38.7	12.7	600	940			4 disc		6 disc				
3/0	Cu	96	27	27	39.3	13.1	650	1,072	25.2	1,070	4 disc		6 disc				
0,000	Cu	120	27	27	38.0	12.5	575	1,524			7 disc		8 disc				
	Cu.—Steel	120	27	27			600	720	*P-P*38 *R-R*22.5		7 disc		8 disc				
									V-V	*V-V*							
	Cu	72 vert.—72 hor	35.0	35	35	6	110	110	0.35	820	1 pin	Thomas, 4,000		6	Hewlett		
2/0	Cu	96 hor.—60 ver	20.0	22	30	6	275	400	4.2	687	1 pin	Ohio Brass, 10,748		6	Hewlett		
	Cu	96 hor.—60 vert	20.0	22	30	6	265	400	6.3	281	4 sus	Thomas, 1,141	6 sus		Thomas, 1,1		
3/0	Eq. Al	252 hor.—156 vert	27.0	27	33.3	9.3	850	1,350	14.5	2,160	9 sus	Locke, 5,757	2 str. of 11 sus		Locke, 5,757		
2/0	Cu	96 hor.—60 vert	20	22	30	6	275	400	4.2	687	1 pin	Ohio Brass, 10,748		6	Hewlett		
2/0	Cu	96 hor.—60 vert	20	27	32	6	275	386	3.8	1,050	1 pin	Ohio Brass, 10,748		6	Hewlett		
	Cu	66 vert	20	22	30	7	225	400	3.5	295	1 pin	Thomas, 4,032	5 sus		Thomas, 1,1		
1/0	Cu.—Eq. Al	96 hor.—72 vert	25	25	30	7	285—210	400—210	3.2—0.7	1,050—1,215	5 sus	Locke, 5,757	6 sus		Locke, 5,757		
	Cu	96 hor.—60 vert	28	28	32	7	250	400	7.4	133	1 pin	Ohio Brass, 10,748	6 sus		Locke, 5,757		
2/0	Cu	96 hor.—60 vert	28.5	28.5	32	7	275	400	3.7	1,050	1 pin	Ohio Brass, 10,748	6 sus		Locke, 5,757		
3/0	Eq. Al	72 vert.—120 hor	29	29	32	7	600—250	1,010—400	8.6—2.0	1,215	4 sus	Locke, 5,757	2 str. of 6 sus		Locke, 5,757		
	Cu	84 hor.—60 vert	24	24	35	6	275	345	9.0	135	1 pin	Thomas, 4,000	5 sus		Thomas, 1,1		
	Eq. Al	96 hor.—72 vert	31.7	31.7	35	6	310	356	2.7	800	4 sus	Thomas, 1,141	5 sus		Thomas, 1,1		
3/0	Eq. Al	96 hor.—60 vert	20	22	30	6	275	350	5.6	570	1 pin	Ohio Brass, 10,748		6	Hewlett		
2/0	Cu	96 hor.—60 vert	28.5	28.5	32	7	275	350	3.7	1,050	1 pin	Ohio Brass, 10,748		6	Hewlett		
	Cu	120	30	30	30	10	600	700	16		4 disc	Ohio Brass	6 disc		Ohio Brass		
2/0	Cu	120	30	30	30	10	600	700	16		4 disc	Ohio Brass	6 disc		Ohio Brass		
	Cu	120	30	30	30	10	600	700	16		4 disc	Ohio Brass	6 disc		Ohio Brass		
	Cu	60	30	30	30	10	300	400	10		1 pin	Ohio Brass	6 disc		Ohio Brass		
	Cu	96	30	30	30	10	300	400	10		4 disc	Ohio Brass	6 disc		Ohio Brass		
3/0	Al	96	30	30	30	10	300	400	10		4 disc	Ohio Brass	6 disc		Ohio Brass		
	Cu	72	30	30	30	10	300	400	10		1 pin	Ohio Brass	6 disc		Ohio Brass		
	Cu	96	30	30	30	10	600	750	16		4 disc	Ohio Brass	6 disc		Ohio Brass		
3/0	Al	96	30	30	30	10	300	900	10		4 disc	Ohio Brass	6 disc		Ohio Brass		
4/0	A. C. S. R	174	26	25	35	9	350	1,110	12	2,350	1 disc	Ohio Brass, Locke	11 disc		Ohio Brass,		
4/0	A. C. S. R	114	25	25	35	10	550	960	12	2,350	4 disc	Ohio Brass	7 disc		Ohio Brass		
1/0	Cu	72	25	25	35	10	275	350	9	940	Pin	Ohio Brass	7 disc		Ohio Brass		
1/0	Cu	96	25	25	35	10	600	800	14	940	4 disc	Ohio Brass	7 disc		Ohio Brass		
3/0	A. C. S. R	78	25	25	35	10	300	400	10		Pin	Ohio Brass	7 disc		Ohio Brass		
	Cu	120	25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc		Ohio Brass		
			25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc		Ohio Brass		
2/0	Al	120	25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc		Ohio Brass		
2/0	Al	120	25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc		Ohio Brass		
2/0	Al	120	25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc		Ohio Brass		
2/0	Al	96	25	25	35	10	300	400	10		4 disc	Ohio Brass	7 disc		Ohio Brass		
4/0	Al	168	34.5		34.5 Min.		550		5.5		9 discs	Locke, Ohio Brass	11 discs		Locke, Ohio B		
4/0	Al	168	34.5		34.5 Min.		550		5.5		9 discs	Westinghouse, 286,270	11 discs		Westinghouse		
1/0	Cu	66—84	28.7		29 Min.	6.5	300		3.1		3 discs	Ohio Brass, 12,464	4 discs		Ohio Brass, 12		
4/0	Cu	66—84	29.5			6.5	250		2.3		Pin	Thomas					
	Cu	86	23		29 Min.	6	300		4.2		Pin						
1/0	Al	86	20.7		29 Min.	5	300		7.5		Pin	Locke, 315					
	Cu	66—84	20.5		30.2 Min.	5	300		3.3		Pin	Locke, Thomas	7 units		Thomas		
	Cu	84	22.3				300		5.8		Pin	Ohio Brass, Thomas, Locke					
	Cu.—Eq. Al	88—72	25—24		30.2 Min.	6—4	225—300		2.0—3.3		Pin	Thomas, Pittsburg					
	Cu	66—84	24—23			6	210—300		2.0—3.3		Pin	Thomas, Locke, Ohio Brass					
	Cu	60	27.2		29 Min.	6	300		5.8		Pin	Locke, 315					
	Cu	72	22.3			6	600		5.8		Pin	Ohio Brass, Pittsburg					
4/0	Cu	6 ft. △	28			7	135				Pin		Z-Z				
4/0	Cu	6 ft. △	28			7	135				Pin		Z-Z				
4/0	Cu	6 ft. △	28			7	135				Pin		Z-Z				
1/0	Cu	6 ft. △	28			7	135				Pin		Z-Z				
4/0	Cu	6 ft. △	28			7	135				Pin		Z-Z				
4/0	Cu	6 ft. △	28			7	135				Pin		Z-Z				
6,400	Al	7 ft. △	42			15	300				Pin		Z-Z				
6,400	Al	7 ft. △	42			15	300				Pin		Z-Z				
4/0	Al	7 ft. △	42			15	300				Pin		Z-Z				
4/0	Al	7 ft. △	42			15	300				Pin		Z-Z				
	Cu	7 ft. △									Pin		Z-Z				
2/0	Al	7 ft. △	42				300				Pin		Z-Z				
	Cu	7 ft. △	42			15	300				Pih		Z-Z				
	Cu	7 ft. △	42			15	300				Pin		Z-Z				
	Cu	7 ft. △	42			15	300				Pin		Z-Z				
	Cu	7 ft. △	42				150				Pin		Z-Z				
	Cu	7 ft. △	42			15	300				Pin		Z-Z				
—4/0	Cu	X-X 14.5 ft.—23.9 ft.	42								6 sus		7 sus		Ohio Brass		
	Cu	5 ft. △	30			7	132				Pin	Ohio Brass, Thomas	3 sus		Locke, 5,800		
4/0	Cu	10 ft. △	30				415				3 sus	Thomas	5 sus		Thomas		
	Cu	7 ft. △	42				250				Pin	Ohio Brass	5 sus				
0,000	Al	7 ft. △	42				150				Pin		3 strain		Jeffrey-Dewitt		
	Cu	7 ft. △	42			15	300				Pin		Z-Z				
0,000	Cu	156					652				10 sus	Ohio Brass	12 sus		Ohio Brass		
0,000	Cu	156					500				10 sus	Ohio Brass	12 sus		Ohio Brass		
0,000	Cu	156					500				10 sus	Ohio Brass	12 sus		Ohio Brass		
	Cu	72					350				3 sus	Ohio Brass	4 sus		Ohio Brass		
	Cu	72									3 sus	Ohio Brass	4 sus		Ohio Brass		
	Cu	72					350				3 sus	Ohio Brass	4 sus		Ohio Brass		
	Cu. and Al	Various					300				Pin	Locke	Pin		Locke		
	Cu	Various									Pin	Locke	Pin		Locke		
	Cu	72					300				3 sus	Ohio Brass	4 sus		Ohio Brass		
	Cu	72									Pin	Locke	Pin		Locke		
	Cu						525				3 sus	Ohio Brass	4 sus		Ohio Brass		
	Cu										3 sus	Ohio Brass	4 sus		Ohio Brass		
	Cu																
	Cu	72									3 sus	Ohio Brass	4 sus		Ohio Brass		
	Cu	72									3 sus	Ohio Brass	4 sus		Ohio Brass		
	Cu	60									Pin	Locke	Pin		Locke		
	Cu	60									Pin	Locke	Pin		Locke		
	Cu	60									Pin	Locke	Pin		Locke		
	Cu	72									Pin	Pittsburgh	Pin		Pittsburg		
	Cu	76									Pin		Pin				
	Cu	72									Pin	Locke	Pin		Locke		
	Cu	72									Pin	Locke	Pin		Locke		
	Cu	72									Pin		Pin		Locke		
4/0	Steel Core Cu	156					325				3 sus.—Pin	Ohio Brass	4 sus.—Pin		Ohio Brass		
2/0	Cu	72					500				5 sus	Ohio Brass	7 sus		Ohio Brass		
	Cu	72					250				Pin	Ohio Brass	Pin		Ohio Brass		
	Cu	72					300				Pin	Ohio Brass	Pin		Ohio Brass		
	Cu	72					300				Pin	Ohio Brass	Pin		Ohio Brass		
	Cu	72					300				3 sus	Ohio Brass	4 sus		Ohio Brass		
	Cu	72									3 sus	Ohio Brass	4 sus		Ohio Brass		
	Cu	72					300				Pin	Ohio Brass	Pin		Ohio Brass		

lts.
d on 10% voltage
es.
rp. and ½ United
e.
river span of 2,011

feet on steel towers.
z—Constructed for 132,000 volts.
A—Stations at each end and in center maintain practically 100% regulation.
B—Ground wire bolted solid to towers. Tower legs considered as ground at each tower.
C—Vertical 120 inch, horizontal 216 inch top and bottom arms, 288 inch middle arms.
E—All stations.
F—Also 39.2 miles, section No. 1, copper, normal span 500 ft. normal sag 20 ft.
G—Also 13 miles, No. 2 copper, normal span 150 ft.
H—Constructed in accord to Nat. Elec. Safety Code No.
I—Missouri River crossing; span 3,400 ft. conductor ½ extra high strength, galv. steel max. tension per conductor 17,000 lb. (½ inch ice, No. 8 wind, and zero deg. F.). Height of north tower 75 ft., height of south tower 170 ft., difference in elev. of tower bases 126 ft.
J—¾-inch cu. clad s
K—Transformer c
1,000 kva.
L—Now carrying 4
for 44,000 volts.
M—Connected and
transformer capacity.
N—N.E.L.A. standa

	None			None	1	7,500				None			Steel				
	Steel									None			None				
	None									None			None				

	None	None		Wood	Wood	Steel					
	None	None		Wood	Wood	Steel					None
	None	None		Steel	Steel	None					None
	None	None		Steel—Wood	Steel—Wood	Steel					None
	None	None		Steel	Steel	None					1
	None	None		Steel	Steel	None					None
	None	None		Steel	Steel	None					None
	None	None		Steel—Wood	Steel—Wood	Steel					None
	None	None		Steel	Steel	None					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	None					None
	None	None		Wood	Wood						None
	None	None		Wood	Wood						None
	None	None		Wood—Steel	Wood—Steel	Steel					1
	None	None		Steel	Steel	None					1
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Steel	Steel	None					None
	None	None		Wood	Wood	Steel					1
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Wood	Wood	Steel					None
	None	None		Steel	Steel	None					None
	None	None		Steel	Steel	None					None
	None	None		Steel	Steel	None					None
	None	None		Wood	Wood	Steel					None
	None	None		Steel	Steel	None					1
	None	None		Steel	Steel	None					1
	None	None		Steel	Steel	None					1
	None	None		Steel	Steel	None					None
	None	None		Steel	Steel	None					None
6 Hewlett	None	None		Wood	Wood	Steel	31.3	1.7			None
6 Hewlett	None	None		Wood	Wood	Steel	34.3	4.8			1
Thomas, 1,141	None	None		Wood	Wood	Steel	29.6	2.0			1
Locke, 5,757	None	None	Blaw-Knox	Steel	Steel	None	44.7	3.2			1
6 Hewlett	None	None		Wood	Wood	Steel	33.8	4.3			None
6 Hewlett	None	None		Wood	Wood	Steel	33.8	4.3			None
Thomas, 1,141	None	None		Wood	Wood	Steel	27.2	3.0			None
Locke, 5,757	None	None		Wood	Wood	None	27.4	10.5			None
Locke, 5,757	None	None		Wood	Wood	Wood	35.3	0.6			None
Locke, 5,757	None	None		Wood	Steel	Steel	35.3	1.1			None
Locke, 5,757	None	None		Wood	Wood	None	29.6	1.0			None
Thomas, 1,141	None	None		Wood	Wood	Steel	33.6	0.1			None
Thomas, 1,141	Yes	None		Wood	Wood	None	35.4	0.5			None
6 Hewlett	None	None		Wood	Wood	Steel	34.3	2.7			None
6 Hewlett	None	None		Wood	Wood	Steel	35.3	1.2			None
Ohio Brass	Yes	None	Am. Br. Co.	Steel	Steel		50	15			
Ohio Brass	Yes	None	Am. Br. Co.	Steel	Steel		50	5			
Ohio Brass	No.	None	Am. Br. Co.	Steel	Steel		50	5			
Ohio Brass	Strain—Yes	None	Am. Br. Co.	Wood	Wood	Steel	50	10			
Ohio Brass	Yes	None		Wood	Wood		50	8			
Ohio Brass	No.	None		Wood	Wood		50	8			
Ohio Brass	Strain—Yes	None		Wood	Wood	Steel	35	8			
Ohio Brass	Yes	None		Wood	Wood		35	8			
Ohio Brass	Yes	None		Wood	Wood		50	8			
Ohio Brass, Locke	Yes	None		Steel	Wood		55—48	15			2
Ohio Brass	None	None		Wood	Wood		50—44	15			
Ohio Brass	None	None		Wood	Wood	Steel	50—51	10			2
Ohio Brass	None	None	Milliken	Steel	Steel		80—64	10			
Ohio Brass	None	None		Wood	Wood	Steel	80—64	10			2
Ohio Brass	None	None		Wood	Wood		40	10			
Ohio Brass	None	None	Milliken	Steel	Steel		90	10			
Ohio Brass	None	None		Wood	Wood		40	8			
Ohio Brass	None	None		Wood	Wood		40	8			
Ohio Brass	None	None		Wood	Wood		40	8			
Ohio Brass	None	None	Milliken	Steel	Steel		40	4			
Locke, Ohio Brass	None	None		Wood	Wood	None	42				2
Westinghouse	None	None		Wood	Wood	None	42				2
Ohio Brass, 12,464	None	None		Wood	Wood	None	33				
	None	None		Wood	Wood	Steel	33				
	None	None		Wood	Wood	Wood	28				2
	None	None		Wood	Wood	Steel	28				2
Thomas	None	None		Wood	Wood	Steel	28.5				2
	None	None		Wood	Wood	Steel	29				
	None	None		Wood	Wood	Steel	28				2
	None	None		Wood	Wood	Steel	27				
	None	None		Wood	Wood	Sttel	34				
	None	None		Wood	Wood	Wood	29				
	None	None		Wood	Wood	Malleable iron		7			None
	None	None		Wood	Wood	Malleable iron		7			None
	None	None		Wood	Wood	Malleable iron		5			None
	None	None		Wood	Wood	Malleable iron		5			None
	None	None		Wood	Wood	Malleable iron		4			None
	None	None		Wood	Wood	Malleable iron		4			None
	None	None		Wood	Wood	Malleable iron		7			None
	None	None		Wood	Wood	Malleable iron		7			None
	None	None		Wood	Wood	Malleable iron		4			None
	None	None		Wood	Wood	Malleable iron		4			None
	None	None		Wood	Wood	Malleable iron					None
	None	None		Wood	Wood	Malleable iron		5			None
	None	None		Wood	Wood	Malleable iron		5			None
	None	None		Wood	Wood	Malleable iron		10			None
	None	None		Wood	Wood	Malleable iron		10			None
	None	None		Wood	Wood	Malleable iron		10			None
	None	None		Wood	Wood	Malleable iron		10			None
Ohio Brass	None	None		Steel	Steel	Malleable iron		10			None
Locke, 5,800	None	None		Wood	Wood	Malleable iron		5			None
Thomas	None	None		Wood	Wood	Malleable iron					None
	None	None		Wood	Wood	Malleable iron					None
Jeffrey-Dewitt	None	None		Wood	Wood	Malleable iron					None
	None	None			Wood	Malleable iron		10			None
Ohio Brass	None	None	Milliken	Steel	Steel						
Ohio Brass	None	None		Wood	Wood						
Ohio Brass	None	None		Wood	Wood						
Ohio Brass	None	None		Wood	Wood						
Ohio Brass	None	None		Wood	Wood						
Ohio Brass	None	None		Wood	Wood						
Locke	None	None		Wood	Wood	Wood					
Locke	None	None		Wood	Wood	Wood					
Ohio Brass	None	None			Wood						
Locke	None	None		Wood	Wood	Wood					
Ohio Brass	None	None	Riter Conley	Steel	Steel						
Ohio Brass	None	None	Am. Bridge	Steel	Steel						
	None	None		Wood	Wood	Wood					
Ohio Brass	None	None		Wood	Wood						
Ohio Brass	None	None		Wood	Wood						
Locke	None	None		Wood	Wood	Wood					
Locke	None	None		Wood	Wood	Wood					
Locke	None	None		Wood	Wood	Wood					
Pittsburg	None	None		Wood	Wood	Wood					
	None	None		Wood	Wood						
Locke	None	None		Wood	Wood	Wood					
Locke	None	None		Wood	Wood	Wood					
Ohio Brass	None	None		Wood	Wood	Wood					
Ohio Brass	None	None		Wood	Wood						
Ohio Brass	None	None		Wood	Wood	Wood					
Ohio Brass	None	None		Wood	Wood	Wood					
Ohio Brass	None	None		Wood	Wood	Wood					
Ohio Brass	None	None		Wood	Wood						
Ohio Brass	None	None		Wood	Wood						
Ohio Brass	None	None		Wood	Wood	Wood					

-inch cu. clad steel.
Transformer capacity at Missoula
va.
Now carrying 40,000 volts, designed
000 volts.
Connected and available step up
rmer capacity.
N.E.L.A. standard.

O—One wire on top arm grounded approx. every ½ mile.
P—At 20 degrees Fahr.
Q—Spaced but not insulated for 110,000 volts.
R—Inter-connected system grounded at center and two ends.
S—Choke coils and horn-gaps.

T—Oxide film and multigap.
U—At present operating at 6,600 volts.
V—Two tower line.
W—Maximum tension pounds.
X—16 to 24 ft. between lines, 10 to 15 ft. between phases, 25 ft. in hills, 30 ft. on level ground.
Y—Capacity of frequency changer at Capistrano.
Z—Capacity of transformers at Escondido.
AA—At Pit only.
CC—Normal load.
DD—Included in distance of 38.38 miles given above.
EE—No. 6 gal. iron wire on every pole.

		Telephone	Same poles				O. C. B.	639			
		Telephone	Same poles								

| | | |

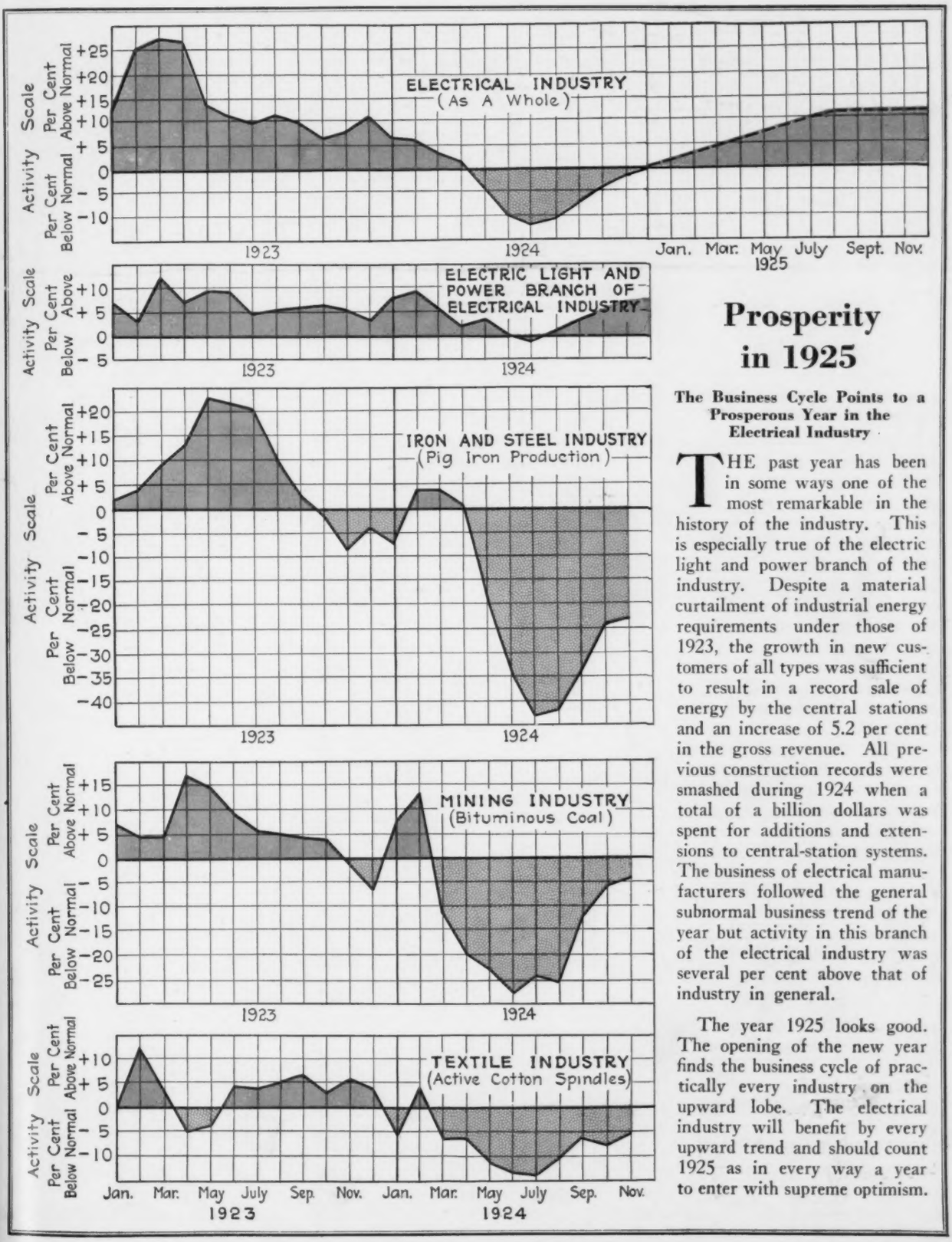
		1	Telephone	Same poles			O. C. B.	639
			Telephone	Same poles	O. C. B.		O. C. B.	640
		1	Telephone	Same poles	O. C. B.		O. C. B.	641
		1	Telephone	Same poles			O. C. B.	642
			Telephone	Same poles	A. B.			643
			Telephone	Same poles	A. B.			644
			Telephone	Same poles	A. B.	O. C. B.		645
			Telephone	Same poles	A. B.	O. C. B.		646
					A. B.	O. C. B.		647
			Telephone	Same poles	A. B.			648
		1	Telephone	Same poles	O. C. B.		O. C. B.	649
		1	Telephone	Same poles	A. B.	O. C. B.	O. C. B.	650
			Telephone	Same poles	A. B.			651
			Telephone	Same poles	A. B.			652
			None		A. B.			653
			None		A. B.			654
			None		A. B.			655
			Telephone	Same poles	A. B.	O. C. B.		656
			Telephone	Same poles	A. B.	O. C. B.		657
			Telephone	Same poles	A. B.			658
			Telephone	Same poles	O. C. B.—A. B.	O. C. B.		659
		1	Telephone	Same poles	O. C. B.		O. C. B.	660
			Telephone	Same poles	O. C. B.—A. B.			661
			Telephone	Same poles	A. B.	O. C. B.		662
			Telephone	Same poles	A. B.			663
			Telephone	Same poles	A. B.			664
			Telephone	Same poles	A. B.		O. C. B.	665
			Telephone	Same poles	A. B.		O. C. B.	666
			Telephone	Same poles	A. B.	O. C. B.		667
			Telephone	Same poles	A. B.	O. C. B.	O. C. B.	668
		1	Telephone	Same poles	O. C. B.—A. B.	O. C. B.		669
			Telephone	Same poles			O. C. B.	670
			Telephone	Same poles			O. C. B.	671
			Telephone	Same poles			A. B.	672
			Telephone	Same poles	O. C. B.—A. B.	O. C. B.		673
			Telephone	Same poles	O. C. B.		O. C. B.	674
			Telephone	Same poles			O. C. B.	675
		2	Telephone	Same poles			O. C. B.	676
			Telephone	Same poles			O. C. B.	677
20 per mi.		1	Telephone	Trans. line	A. B.—O. C. B.	A. B.—O. C. B.		678
20 per mi.		1	Telephone	Trans. line	A. B.—O. C. B.	O. C. B.		679
20 per mi.		1	Telephone	Trans. line	A. B.	A. B.—O. C. B.		680
None	None		Radio-wired and wireless	Wichita and Neosho	O. C. B.	O. C. B.		681
20 per mi.		1	Telephone	Trans. line	A. B.	O. C. B.		682
24 per mi.		1	Telephone	Trans. line	A. B.	O. C. B.		683
24 per mi.		1	Telephone	Trans. line	A. B.—O. C. B.	O. C. B.		684
19 per mi.	None		Telephone	Trans. line	A. B.—O. C. B.	O. C. B.		685
None	None		Telephone	Trans. line	A. B.—O. C. B.	O. C. B.		686
None	None		Telephone	Trans. line	A. B.—O. C. B.	O. C. B.		687
None	None		Telephone	Trans. line	A. B.—O. C. B.	O. C. B.		688
20 per mi.	None		Telephone	Trans. line	None	None		689
18 per mi.		1	Telephone	Trans. line	None	None		690
19 per mi.		1	Telephone	Trans. line	A. B.—O. C. B.	O. C. B.		691
None	None		Telephone	Trans. line	A. B.—O. C. B.	O. C. B.		692
All trans.		1	Telephone	10 feet under H. T.	Oil—Air	Oil		693
All trans.		1	Telephone	10 feet under H. T.	Oil—Air	Oil		694
All trans.		1	Telephone	10 feet under H. T.	Oil—Air	Oil		695
All poles	None		Telephone	10 feet under H. T.	Oil—Air	Oil		696
All poles	None		Telephone	10 feet under H. T.	Oil—Air	Oil		697
All poles	None		Telephone	10 feet under H. T.	Oil—Air	Oil		698
All poles	None		Telephone	10 feet under H. T.	Oil—Air	Oil		699
All poles	None		Telephone	10 feet under H. T.	Oil—Air	Oil		700
All poles	None		Telephone	10 feet under H. T.	Oil—Air	Oil		701
								702
								703
Every tower			Telephone	Power lines				704
Every tower			Telephone	Rented	Oil and air	O. S.		705
All poles			Telephone	Power lines	Oil and air	O. S.		706
All poles			Telephone	Power lines	Oil and air	O. S.		707
All poles			Telephone	Rented	Oil and air	O. S.		708
All poles			Telephone	Power lines	Oil and air	O. S.		709
All poles			Telephone	Power lines	Oil and air	O. S.		710
All poles			Telephone	Power lines	Oil and air	O. S.		711
All poles			Telephone	Rented	Oil and air	O. S.		712
								713
								714
			Telephone	Same poles				715
			Telephone	Same poles				716
			Telephone	Same poles				717
			Telephone	Same poles				718
			Telephone	Same poles				719
			Telephone	Same poles				720
			Telephone	Same poles				721
			Telephone	Same poles				722
			Telephone	Same poles				723
			Telephone	Same poles				724
			Telephone	Trans. poles	Yes			725
			Telephone	Trans. poles	Yes			726
			Telephone	Trans. poles	Yes			727
					Yes			728
			Telephone	Trans. poles	Yes			729
					Yes			730
			Telephone	Trans. poles	Yes			731
			Telephone	Trans. poles	Yes			732
			Telephone	Trans. poles	Yes			733
					Yes			734
			Telephone	Trans. poles	Yes			735
			Telephone	Trans. poles	Yes			736
					Yes			737
			Telephone	Trans. poles	Yes			738
			Telephone	Trans. poles	Yes			739
			Telephone	Trans. poles	Yes			740
			Telephone	Trans. poles	Yes			741
					Yes			742
					Yes			743
					Yes			744
					Yes			745
					Yes			746
			Telephone	Trans. poles	Yes			747
Each structure		2						748
Each structure		2						749
Each structure		2						750
Each structure		1						751
Each structure		1						752
Each structure		1						753
Each structure		1						754
Each structure		1						755
Each structure		1						756
Each structure		1						757
Each structure		2						758
Each structure		2						759
								760
Each structure		1						761
Each structure		1						762
								763
								764
								765
								766
								767
								768
								769
								770
Each structure		1						771
								772
								773
								774
Each structure		1						775
Each structure		1						776
								777

T—For 250,000 c.m. conductor.
U—For ⅜-inch steel conductor.
V—Based on 5% loss.
W—Based on 10% loss.
X—Constructed for 132,000 volts.
Y—60 degrees Fahr.
Z—Ground where high tension side is the star side.

aa—Geometric mean.
bb—At numerous points on the system oxide film or electrolytic arresters are installed sometimes on the bus and sometimes on individual lines.
cc—After renewals and relocations in recent years 5 or 6 suspension type insulators used for strains and dead ends.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business



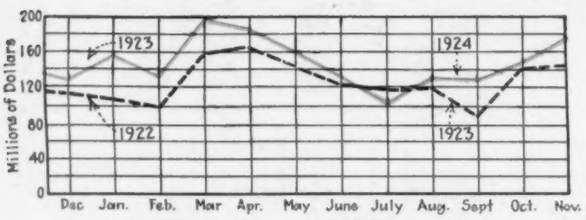
Prosperity in 1925

The Business Cycle Points to a Prosperous Year in the Electrical Industry

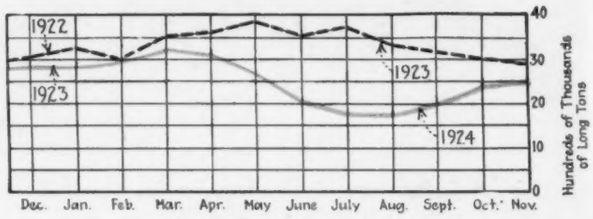
THE past year has been in some ways one of the most remarkable in the history of the industry. This is especially true of the electric light and power branch of the industry. Despite a material curtailment of industrial energy requirements under those of 1923, the growth in new customers of all types was sufficient to result in a record sale of energy by the central stations and an increase of 5.2 per cent in the gross revenue. All previous construction records were smashed during 1924 when a total of a billion dollars was spent for additions and extensions to central-station systems. The business of electrical manufacturers followed the general subnormal business trend of the year but activity in this branch of the electrical industry was several per cent above that of industry in general.

The year 1925 looks good. The opening of the new year finds the business cycle of practically every industry on the upward lobe. The electrical industry will benefit by every upward trend and should count 1925 as in every way a year to enter with supreme optimism.

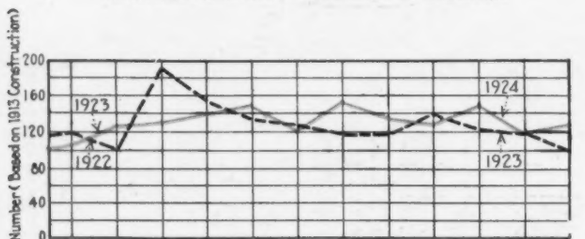
How the Primary Industries Are Trending



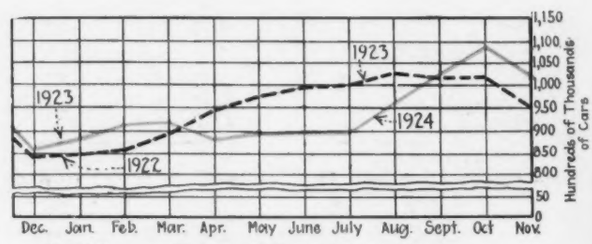
Contracts Awarded for Residential Buildings



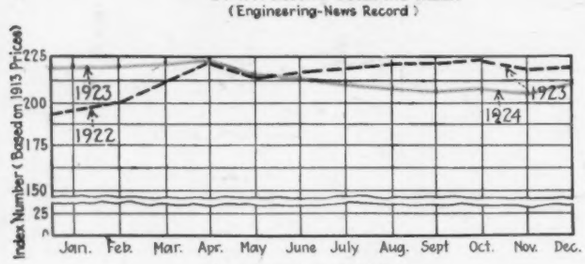
Pig-Iron Production



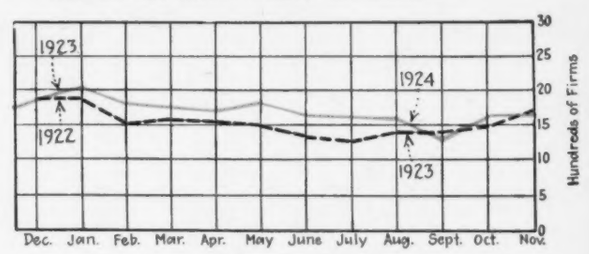
Construction Volumne Index
(Engineering-News Record)



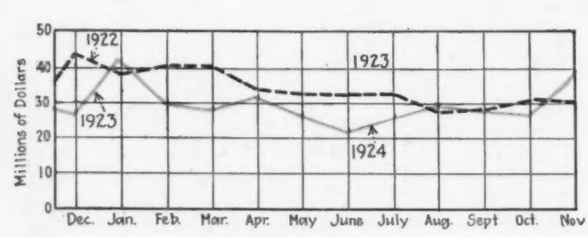
Total Average Weekly Freight-Car Loadings



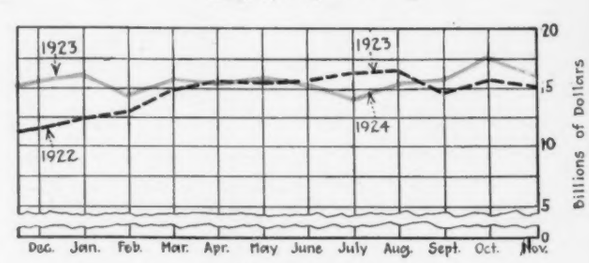
Construction Cost Index
(Engineering-News Record)



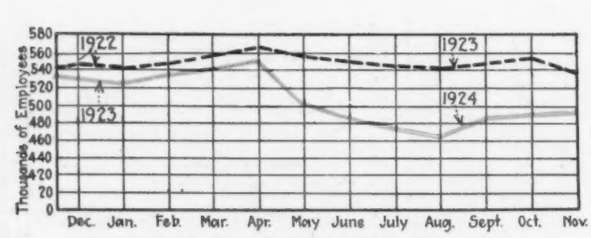
Business Failures



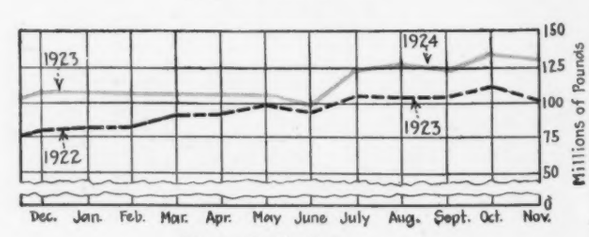
Fire Losses



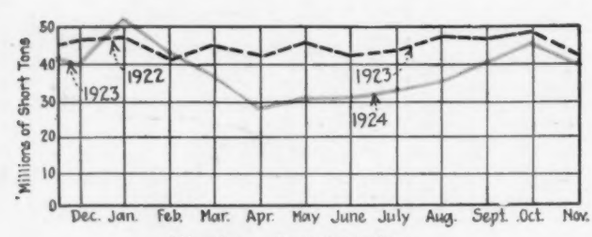
Bank Clearings
(Outside of New York City)



Employees in Factories of New York State



Copper Production



Bituminous Coal Production

The Election Inspires Business Confidence

DURING November general business took on a spirit of optimism and confidence, the reassuring influence of the election, and the natural result was a quickening of trade and industry. Most industries were, however, still operating below their estimated normals.